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FOREIGN MILITARY REVIEW

U.S. Rapid Deployment Force

18010065a Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 3-10

[Part 1 of article by Col S. Semenov]

[Text] In implementing their hegemonic plans U.S. ruling circles are governed by long-range concepts adopted back in the first postwar years: "global deterrence" and later "throwing back communism". Even at the present time they consider unlimited, open and "legitimized" (from the U.S. standpoint) intervention, including military intervention, in the affairs of developing countries to be one way to attain these objectives. Washington strives not only to keep these states in its sphere of influence at all cost and thus ensure free access to raw material resources, but also to use their territories as a springboard for achieving far-reaching military-political objectives directed above all against the USSR, especially in strategically important regions of the world such as the Near East, Northeast Africa, and the sea and ocean areas contiguous with them. U.S. ruling circles consider the so-called Rapid Deployment Force [RDF] which they created to be the principal tool for implementing these schemes, this time in accordance with the doctrine of "neoglobalism."

The idea of creating mobile forces to "protect vital American interests" by military intervention in the affairs of states "disobedient" to Washington arose among militant representatives of U.S. ruling circles back in the late 1950's. It crystallized once and for all and acquired real outlines and a material basis in the latter half of the 1970's. It was then, as the NEW YORK TIMES reported, that former U.S. President Carter issued Presidential Directive No 18 based on a special report prepared by the Pentagon in 1978 entitled "Military Options in the Persian Gulf." This directive marked the beginning of practical measures by the American Defense Department for establishing the RDF. This was announced in July 1979 by Gen Rogers, who at that time was U.S. Army Chief of Staff. The troops which the Pentagon began establishing were at first called the Rapid Reaction Force. This was taken to mean rapid planning of these forces' operational employment, their movement and deployment in the operational mission area, and their immediate tactical employment.

On 1 March 1980 the U.S. Defense Department announced that the headquarters of a special troop contingent, which now was already being called the RDF, had been activated at MacDill Air Force Base, Florida and a CIC had been appointed. Despite the substitution of "Deployment" (a term with a broader meaning) for the term "Reaction," the substance and missions of the RDF remained the same—"protection" of so-called "vital interests" of the United States in any part of the world outside the "zone of responsibility" of NATO, imperialism's main aggressive bloc. As before, the force was given the role of a Pentagon "fire brigade" possessing flexibility in employment, strategic mobility, sufficient power and autonomy necessary for conducting lengthy military actions on a varying scale from the participation of one or more battalions in small local conflicts to large-scale operations in the region by forces of corps and larger formations including contingents of all branches of armed forces of the United States as well as of countries with pro-American regimes situated within a given part of the world.

The RDF command element (the CIC with his staff, numbering around 300 persons representing the Army, Air Force, Navy and Marines) was directly subordinate to the CIC of the unified U.S. Readiness Command up until October 1981. Territorially it was situated together with (and in fact was a component part of) the Headquarters, U.S. Readiness Command, having only a small liaison group with the Joint Chiefs of Staff [JCS] especially for coordinating questions of operational planning and tactical employment of the large and small units of all branches of armed forces assigned to the RDF. These contingents, the strength of which was set at approximately 200,000 regular troops and up to 100,000 from reserve components (chiefly for accomplishing combat and logistical support missions), were not included in the RDF organizationally on a permanent basis. In peacetime they were not subordinate to the RDF headquarters even operationally, but were assigned to it by direction of the JCS in case of necessity. It is known, however, that specific units and the fighting and numerical strength of the RDF as a whole were determined by the JCS in each specific instance depending on the objectives and presumed scale of the conflict in which they were to take part.

The RDF role and place in the system of American armed forces as well as views on its organizational development and tactical employment underwent noticeable changes after the present administration came to power in the United States in 1980. It was removed from the U.S. Readiness Command in October 1981 and was directly subordinated to the supreme commander of U.S. Armed Forces through the JCS; a Rapid Deployment Joint Task Force was formed on its basis, with the Army's 82d Airborne Division and 101st Airmobile Division and 11 tactical air squadrons operationally subordinated to it on a permanent basis. It could be given up to two carrier groups, a Marine Expeditionary Division and up to two squadrons of B-52 strategic bombers in operational subordination for the time of an operation if necessary to accomplish larger scale missions as well as for actions in coastal sectors. There were also provisions to use strategic reconnaissance aircraft, airborne command posts and E-3 AWACS aircraft in support of an operation by such a grouping.

The CIC and staff of the RDF were assigned missions of drawing up operations plans for employing the RDF in

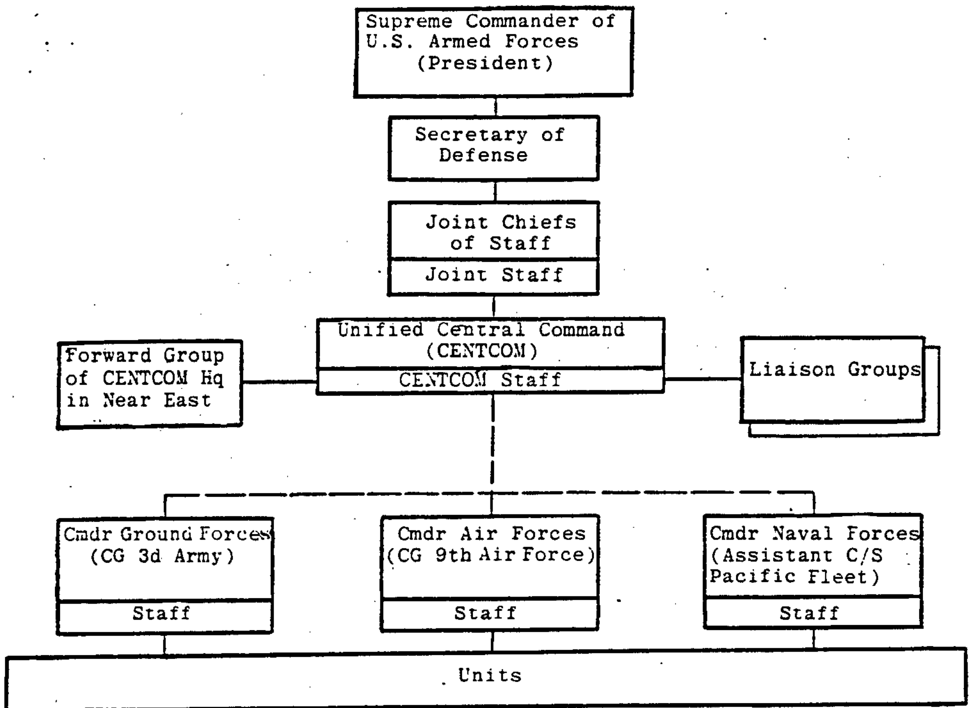

Fig. 1. Block diagram of unified Central Command organization

Southwest Asia, organizing and conducting combat training, and monitoring the state of combat readiness of units assigned to the RDF.

A unified Central Command (also known in the press as CENTCOM) was established in January 1983 on the basis of the existing RDF. Its legal status, sphere of responsibility, scope of missions and contingents of assigned forces considerably expanded in comparison with all previous variants of their employment. It was made an important independent structural unit (Fig. 1) in the system of operational organization of U.S. Armed Forces for which a geographic "zone of responsibility" has been allocated. The RDF is a special contingent specified by the JCS as the basis for planning military intervention and including the most combat-ready and highly mobile units (ships) of all branches of the Armed Forces. Groupings of troops (forces) of varying composition can be established and deployed on their basis for conducting combat actions within the command's "zone of responsibility". Judging from statements by foreign specialists, CENTCOM and the RDF represent a dual concept. Therefore both these expressions frequently are used as equivalent in American military terminology.

The unified CENTCOM staff is located at MacDill Air Force Base and is an expanded version of the RDF staff which existed there before establishment of CENTCOM. It is manned by personnel representing all branches of the armed forces and numbers some 1,000 persons. Organizationally it includes six directorates (military policy, operations, intelligence, personnel, communications and electronics, logistics), and liaison (coordination) groups are assigned with the JCS Joint Staff and Headquarters, U.S. Armed Forces Europe which are constantly with these military control bodies.

The primary missions of the CIC (General G. Crist) and the CENTCOM staff are to draw up plans for the RDF's operational deployment in the command's "zone of responsibility"; plan, organize and conduct operational and combat training of units earmarked for assignment to this force; check the status of its combat and mobiliztion readiness; and direct operations of an RDF grouping moved to an area of military conflict. In addition, it is their duty to draw up recommendations for the U.S. military-political leadership on questions of military assistance including arms sales and personnel training for armed forces of Washington's satellite countries situated in the command's "zone of responsibility," as well as to organize and supervise measures being taken by American military specialists and engineer units to improve the operational organization of these states' territories in the interests of the RDF's tactical employment.

The Southwest Asia region including the Near and Middle East, North and Northeast Africa, as well as coastal water areas of contiguous seas and the Indian Ocean in which the Pentagon is attemting to establish various military installations in advance, has been officially declared the CENTCOM "zone of responsibility" (Fig. 2). This zone specifically includes 19 states—

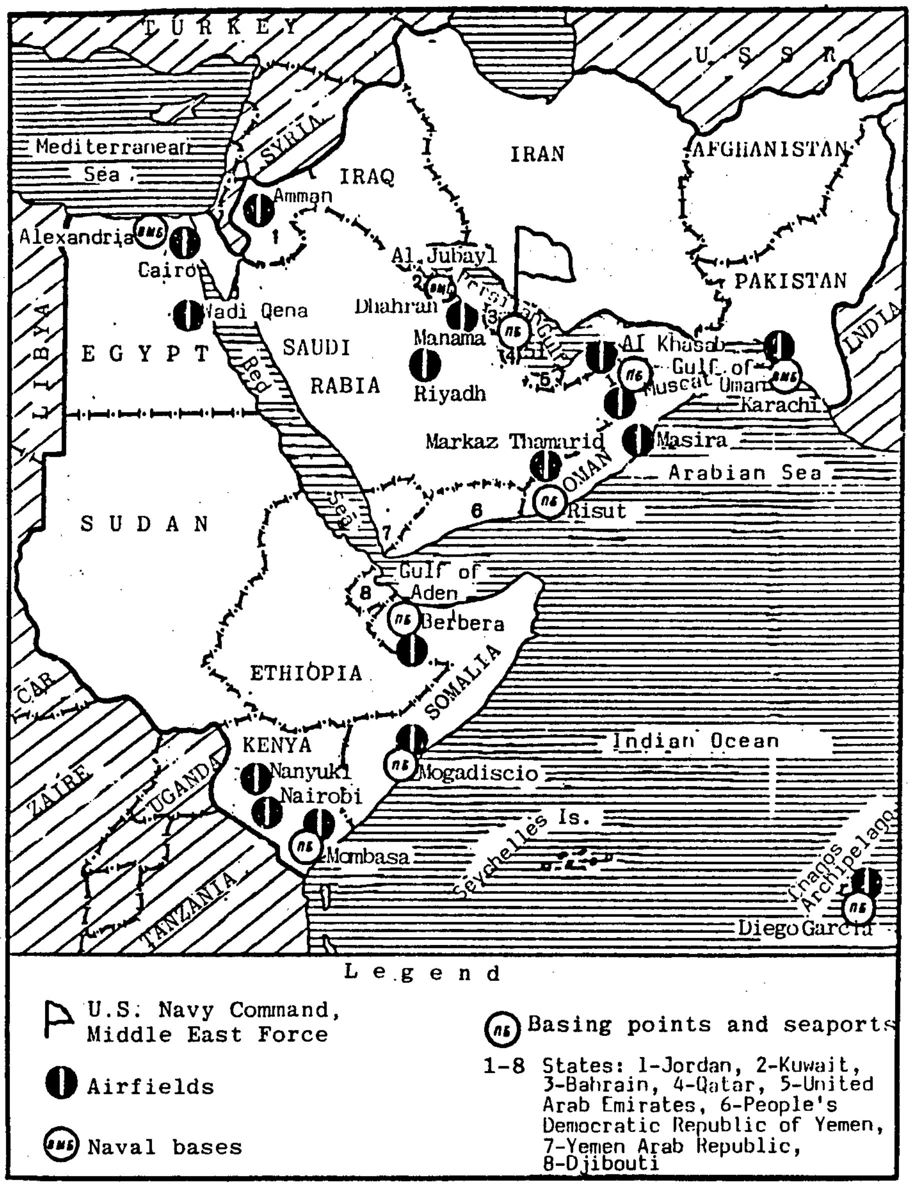

Fig. 2. Principal installations in CENTCOM "zone of responsibility" used permanently or periodically by the Pentagon

Afghanistan, Bahrain, Djibouti, Egypt, Iraq, Iran, Jordan, Yemen Arab Republic, People's Democratic Republic of Yemen, Qatar, Kenya, Kuwait, United Arab Emirates, Oman, Pakistan, Saudi Arabia, Somalia, Sudan and Ethiopia. The overall area of their territory is around 13 million km^2 on which over 350 million persons live. The CENTCOM "zone of responsibility" extends around 5,000 km from north to south and almost 4,500 km from east to west. The territories of Israel, Syria and Lebanon related to this region are not included in the CENTCOM "zone of responsibility." The U.S. military-political leadership considers them as an especially explosive area requiring Washington's heightened attention and monitoring.

The principle applied in putting together the RDF's fighting strength assigned for actions in the command's "zone of responsibility" is that under ordinary (peacetime) conditions there are no specific units (ships) at the disposal of CENTCOM Headquarters with the exception of the Army 82d Airborne and 101st Airmobile divisions and the 11 tactical air squadrons operationally subordinate to it. The JCS decides specific Army and Marine units as well as the numerical level of contingents of other branches of the Armed Forces which can be assigned to the RDF for missions in the command's "zone of responsibility" in case a military conflict arises there. This make-up can vary from a battalion to a large

strategic formation including a number of large and small units and subunits of the Army, Air Force, Navy and Marines as well as Special Forces. The fighting and numerical strength of the grouping is determined by the JCS in each specific instance depending on the character and scale of the military conflict in which it is to fight. Judging from foreign press reports, under the maximum variant it can include the following headquarters and large and small units.

From the Army: Headquarters 3d Army, XVIII Airborne Corps (82d Airborne Division, 101st Airmobile Division, 24th Mechanized Division and 1st Corps Support Command), 9th Mechanized Division and 7th Light Infantry Division as well as the 6th Separate Antitank Helicopter Brigade, one Special Forces group ("Green Berets") and up to two Ranger battalions (a total of over 135,000 persons including 3,500 servicemen of special units).

From the Air Force: Headquarters 9th Air Force; seven tactical air wings including one Air Force National Guard wing; four fighter groups and one separate fighter squadron; a reconnaissance group and Air Force National Guard EW group; an AWACS wing (E-3's); a special air wing; as well as two squadrons of B-52 strategic bombers (a total of 33,000 persons).

From the Navy (Navy and Marines): an operations group of Seventh Fleet Headquarters; up to three carrier-based groups; one ship-based strike group; amphibious landing groups; five squadrons of Orion P-3C land-based patrol aircraft; a group of store ships with heavy weapons, military equipment and logistics usually located in the vicinity of Diego Garcia Island (for one Marine Expeditionary Brigade and a number of forward Army and Air Force units); one Marine Expeditionary division; and one Marine Expeditionary Brigade (a total of around 120,000 persons, including 70,000 Marines).

The total strength of the RDF counting the CENTCOM staff can be around 300,000 regular forces. Such a grouping can have more than 450 tanks, around 1,500 field artillery pieces and mortars, over 3,000 antitank weapons, approximately 600 surface-to-air missiles, up to 1,000 Air Force and Naval Aviation combat aircraft, over 1,300 helicopters, 40 or more combatant ships of the main types including three carriers, one battleship and a number of other ships and submarines equipped with Tomahawk cruise missiles. It was reported that a portion of these forces earmarked for actions in the CENTCOM "zone of responsibility" also can be used in other TVD [theaters of military operations], particularly in areas of the Pacific Ocean, Central and South America as well as in Europe, depending on the military-strategic situation taking shape in the world.

Foreign specialists believe that to accomplish missions of combat and logistical support of the main RDF grouping approximately another 100,000 servicemen can be assigned to it from units and subunits of U.S. Armed Forces' reserve components. Thus the total strength of the contingent of troops (forces) earmarked for the RDF can exceed 400,000.

All large units, small units (ships) and subunits earmarked for employment in the CENTCOM "zone of responsibility" are assessed by foreign specialists as being the most combat-ready and sufficiently manned and trained. In the foreign specialists' opinion, those forces are being kept in a high state of readiness and have sufficient mobility and combat stability. For example, it was reported that the 7th Light Infantry Division and 9th Mechanized Division are qualitatively new units created in recent years under an Army modernization program known as "Army-90." They have a flexible organizational structure, are air-transportable and are adapted, trained and appropriately outfitted for mobile combat actions in a theater of military operations poorly organized in the operational sense and under difficult physical-geographic conditions. The Pentagon is trying to give similar qualities also to the 82d Airborne Division, 101st Airmobile Division as well as the 6th Separate Antitank Helicopter Brigade formed earlier. In addition, these units have high tactical mobility because of the presence within them of a large number of helicopters (around 220 in the 82d Airborne Division, over 400 in the 101st Airmobile Division and around 340 in the 6th Separate Antitank Helicopter Brigade).

The Marine Expeditionary Division is the basic operations unit earmarked for conducting major amphibious landing operations in the CENTCOM "zone of responsibility" independently or in coordination with naval ship groupings and units of other branches of the Armed Forces assigned to the RDF. In addition to the Marine division proper, the Marine Expeditionary Division includes a Marine aircraft wing, logistics group and other subunits. The unit's strength can reach 50,000 persons and it has up to 70 tanks, over 270 field artillery pieces and mortars, over 400 antitank weapons, up to 100 surface-to-air missiles, over 400 aircraft and helicopters as well as over 350 infantry fighting vehicles and amphibious APC's. Such a large unit can be moved to Southwest Asia by sea in 30 days from the moment an order is received and can conduct combat actions independently for a month.

The Marine Expeditionary Brigade is an operational-tactical unit and, like the Marine Expeditionary Division, is earmarked for conducting an amphibious landing operation in the CENTCOM "zone of responsibility" independently or in coordination with naval ships and units of other branches of the Armed Forces assigned to the RDF. Personnel strength of the brigade can reach 16,000. It usually includes a Marine regimental landing team, a composite aircraft group and a brigade service support group. Such a unit can have over 50 tanks, more than 120 guns and mortars, around 200 TOW and Dragon antitank guided missile systems and other antitank weapons, up to 100 surface-to-air missiles, more than 100 infantry fighting vehicles and

amphibious APC's, and around 200 combat aircraft and helicopters. If necessary it is also planned to move Marine Expeditionary Brigade personnel with personal weapons to the operational mission area of the CENTCOM "zone of responsibility" by air using U.S. Air Force Military Airlift Command aircraft. This will require up to 5-7 days, and the brigade's complete readiness to conduct combat actions can be reached in approximately 10 days from the moment the order is received. It is believed that such time periods are dictated by the movement time to the conflict area of store ships with heavy weapons, military equipment and supplies sufficient for approximately 30 days of combat actions.

In the opinion of foreign military specialists, the landing of a Marine Expeditionary Division or Marine Expeditionary Brigade in the CENTCOM "zone of responsibility" can be preceded by a landing operation to seize a beachhead (ports, airfields) using forces of a Marine Expeditionary Battalion, which is commonly known to be permanently stationed even in peacetime aboard ships of an amphibious assault group operating near the area of the proposed amphibious landing operation. It is the basic tactical subunit (it numbers up to 2,500 persons) of the U.S. Marines and includes a battalion landing team, composite aircraft squadron and battalion service support group. It can have up to five medium tanks, six 155-mm howitzers, 40 antitank guided missile systems, around 20 mortars, approximately 20 Stinger shoulder-fired surface-to-air missile systems, almost 30 assault helicopters and 15 amphibious APC's. It can take up to two days to land such a battalion to seize a beachhead in the vicinity of an amphibious landing operation.

Large and small units of the Army and Marines earmarked for actions as part of the RDF have M1 Abrams and M60A1 tanks which surpass vehicles of old modifications by 1.5-2 times in their combat characteristics, the M2 Bradley infantry fighting vehicle, M3 combat reconnaissance vehicle, LAV Marine combat vehicles, antitank weapons (TOW and Dragon antitank guided missile systems in the transportable and portable versions), surface-to-air missiles (Stinger shoulder-fired surface-to-air missile system), antitank helicopters (equipped with TOW and Hellfire antitank guided missiles), self-propelled howitzers and tractor-drawn (modernized) howitzers capable of employing chemical, rocket-assisted (range of around 30 km), cluster, and guided projectiles with laser homing head, as well as MLRS multiple launch rocket systems. Army and Marine aviation units and subunits assigned to the RDF are equipped with fire support helicopters (AH-1 Cobra-TOW and AH-64 Apache), versatile general-purpose helicopters (UH-60 Black Hawk), medium and heavy assault transport helicopters (CH-47 Chinook and CH-53 Super Stallion).

Air Force and naval (deck-based and Marine) tactical aviation assigned to the RDF have F-111, F-4, F-14, F-15 and F-16 tactical fighters, A-10, A-6E, A-7E and AV-8A attack aircraft and F/A-18 fighter-attack aircraft equipped with air-to-surface and air-to-air guided missiles. They are capable of accomplishing a wide range of missions assigned to aviation in the modern action and operation (winning supremacy in the air and at sea, interdiction of the combat zone, close air support of ground troops and other missions).

Carrier groups with up to ten combatant ships in each (aircraft carrier, cruisers, destroyers, frigates, Fig. 3 [figure not reproduced]) are the main strike force of the U.S. Navy as part of the RDF. A deck-based air wing numbering 90 or more aircraft (attack aircraft, fighters, ASW aircraft) and helicopters, of which up to 40 are nuclear weapon platforms, is based on a carrier.

A ship striking force can include up to five combatant ships headed by a battleship armed with modern missiles, including Tomahawk cruise missiles fitted with both nuclear and conventional warheads for delivering strikes not only against naval targets, but also against ground (shore) targets, and with Harpoon antiship missiles.

Amphibious landing groups (up to three) assigned to the RDF are intended for moving Marines rapidly to the operational mission area and for landing amphibious assault forces. A group can have up to eight landing ships, including one helicopter carrier and one or two general-purpose landing ships.

Squadrons of naval land-based patrol aviation with up to nine P-3C Orion aircraft can be employed for supporting actions of the sea component of the RDF in ocean and sea theaters. They are capable of accomplishing missions of hunting and killing submarines over large ocean expanses, participating in the defense of ship forces assigned to the RDF and of sea lines of communication over which reinforcing troops are being moved, and giving comprehensive logistical support to the grouping in the CENTCOM "zone of responsibility."

To support strategic air and sea movements of troops and military cargoes to the CENTCOM "zone of responsibility" in case a military conflict breaks out there, it is planned initially to place in service some of the forces of the U.S. Air Force Military Airlift Command's military transport aviation and then also marine transport vessels of the U.S. Navy Military Sealift Command. According to American press data, C-5A Galaxy and C-141 Starlifter aircraft of the U.S. Military Airlift Command can move a light infantry division from the United States to Southwest Asia in four days, an airborne division in 8.5 days, an airmobile division in 9.5 days and a mechanized division in 11 days when a military conflict begins. Subsequently it is planned to use an additional number of transport aircraft for air movements if necessary by mobilizing civil aviation of the Military Airlift Command Reserve (widebody Boeing-747, DC-10, Boeing-707, L-1011 and other aircraft).

More than 30 vessels can be placed in service from the authorized strength (up to 80 vessels) of the Military Sealift Command immediately in RDF interests to carry out marine movements into the CENTCOM zone. This number includes 17 store ships located near Diego Garcia Island with stores of heavy weapons, military equipment and supplies (intended above all for the 7th Marine Expeditionary Brigade and forward Army and Navy units assigned to the RDF). The remaining vessels (up to 15) can be used for moving the 24th Mechanized Division or 101st Airmobile Division as well as the 6th Separate Antitank Helicopter Brigade at full strength from the United States to the Persian Gulf area, which in the estimates of foreign specialists will require 30-35 days.

The U.S. military-political leadership is figuring on using more than 40 military installations (bases, airfields, ports, naval basing points) and other facilities located on the territories of a number of countries of this region (see Fig. 2) to receive troops and military cargoes being moved from the United States to the CENTCOM "zone of responsibility" as well as to support RDF deployment and combat actions in this region of the world. In particular, in 1980 the U.S. military-political leadership gained the consent of the governments of Oman, Somalia and Kenya and in 1982 also of Morocco for using air space and military and civilian facilities on their territories in RDF interests. Egypt, Israel, Jordan, Djibouti, Saudi Arabia, Pakistan, Bahrain and Kuwait periodically make their territories and military installations available to the Pentagon for these same purposes. Lately Washington has been undertaking vigorous efforts to achieve agreements with those countries as well as with Portugal on using their infrastructure facilities and air space over their territories in RDF interests on a permanent basis.

The foreign press emphasizes that despite an absence for now of official agreements with the majority of those countries, the Pentagon even in peacetime already is periodically using airfields on Diego Garcia Island (a possession of Great Britain), at Markaz Thamarid and Masira (Oman), and at Cairo (West) and Wadi-Qena (Egypt) as forward Air Force bases. Military installations in Karachi (Pakistan); Masira (Oman); Nairobi, Nanyuki and Mombasa (Kenya); Mogadiscio and Berbera (Somalia) and other cities periodically are placed in service as naval bases and fleet basing points, and as airfields for U.S. Navy land-based patrol aviation. Work to improve and expand installations is being done at the majority of the aforementioned facilities with U.S. funds and with the participation of American specialists. Runways are being lengthened and renovated there; POL, ammunition and other logistics depots as well as personnel barracks are being built; and navigation and airfield equipment is being updated. Airfields on Diego Garcia, at Cairo West and at Markaz Thamarid already have been re-equipped and are capable of accepting B-52 strategic bombers. The U.S. Congress appropriated a total of more than $100 million for fiscal years 1987-1991 for modernizing military bases and other installations in CENTCOM interests.

(To be continued)

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U.S. Army Battalion Tactical Groups

18010065b Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 17-23

[Article by Lt Col K.Volodin]

[Text] In accordance with a widescale program to build up the might of its Armed Forces, the U.S. Army command is taking active steps aimed at significantly increasing tactical capabilities of units and subunits by outfitting them with the latest weapons and military equipment as well as by improving the organization and establishment, and it is revising views on their tactical employment.

Adoption of the Army "Air-Land Operation (Battle)" concept, reflecting the American command's qualitatively new views on the nature of combat actions under present-day conditions, also is practical confirmation of this.* Basic field regulations, manuals and instructions governing questions of operational and combat training of staffs and troops were revised in accordance with this concept.

It is believed that success is achieved in combat by decisive defeat of the enemy through coordinated actions of formations of various arms of the ground forces with tactical air units and subunits, and with units and subunits of naval forces for combat actions in coastal sectors. Special attention here is given to the simultaneous deep engagement of all elements of the operational alinement (combat formation) of enemy troops by modern weapon systems, and precision ones above all.

In the opinion of American military specialists, fuller realization of basic provisions of the new concept (initiative, depth, speed and coordination of actions) is achieved at a tactical level as a result of the tactical employment of combined-arms subunits placed together in battalion tactical groups and permitting sufficiently effective employment of contemporary models of weapons and combat equipment in their inventory (M1 Abrams tanks, M2 Bradley infantry fighting vehicles [IFV], M901 self-propelled antitank missile systems, AH-64A Apache fire support helicopters with Hellfire

antitank guided missiles, and others). This article examines the mission, possible fighting strength and features of employment of battalion tactical groups formed on the basis of mechanized and tank subunits in basic forms of combat.

Mission and possible fighting strength. Judging from foreign press reports, battalion tactical groups are formed by decision of the brigade commander and are intended for entering into immediate contact with the enemy to destroy his personnel and weapons by a combination of fire and maneuver in coordination with subunits and units of other ground arms and branches of the Armed Forces. Depending on composition they can be of three types: mechanized (usually a mechanized battalion with one or two attached tank companies), tank (it is planned to form them on the basis of a tank battalion with one or two attached mechanized companies), and balanced (they have an equal number of mechanized and tank companies). As reinforcement a group can be given the attachment of a Vulcan self-propelled air defense platoon (four mounts), a Stinger shoulder-fired surface-to-air missile section (five fire teams), engineer subunits (four tank bridgelayers and up to six all-purpose engineer excavators), and a chemical reconnaissance squad.

The mechanized battalion (896 persons), which is the basis of the mechanized battalion tactical group, includes a headquarters and six companies (headquarters company, four mechanized companies and an antitank company). It has 54 M2 Bradley IFV's, 6 M3 combat reconnaissance vehicles, 12 M901 TOW antitank guided missile systems, 36 Dragon antitank guided missile launchers, 6 106.7-mm self-propelled mortars, 23 M113A1 APC's, 8 M577A1 command and staff vehicles, more than 110 motor vehicles, some 250 radios and other materiel.

The tank battalion (523 persons) has five companies (headquarters company and four tank companies). It has 58 M1 Abrams tanks, 6 M3 combat reconnaissance vehicles, 6 106.7-mm self-propelled mortars, 11 M113A1 APC's, 8 M577A1 command and staff vehicles, some 90 motor vehicles, over 170 radios and so on.

According to calculations by American specialists, the tactical capabilities of the battalion tactical group (mechanized, tank or balanced) will be determined by its fighting strength, nature of actions, terrain conditions in the combat zone, weather and time of day. For example, the mechanized battalion tactical group can advance on a frontage of up to 5 km (the mechanized battalion on a frontage of from 2 to 3.5 km), and by creating over a threefold superiority over the enemy it can penetrate a deliberate enemy defense on a frontage of up to 1 km. On defense it can be assigned a defense area (firing position or strongpoint) 5-8 km (up to 5 km) wide and up to 12 km (3 km) deep. The frontage of advance of a tank battalion tactical group (for a tank battalion it is 3 km or more), width and depth of defense area (3-5 km) are similar to norms given above for the mechanized battalion tactical group.

Features of tactical employment of battalion tactical groups. American military specialists state that the establishment of battalion tactical groups for a period of combat actions is not something new in tactics of U.S. Army subunits and units, but with the adoption of the "Air-Land Operation (Battle)" concept certain features appeared in their tactical employment. For example, primary attention is to be given to seizing and holding the initiative, conducting combat actions to a considerable depth, maneuvering with the objective of inflicting damage on the first and subsequent enemy echelons, organizing thorough reconnaissance and so on.

According to the Army command's views, the **offensive** is the basic form of combat actions, since only during an offensive can the decisive objectives of defeating the enemy, capturing important objectives and terrain areas, disorganizing the command and control system and so on be achieved. It is believed that an offensive can create favorable conditions for imposing one's will on the enemy, seizing the initiative and taking advantage of the enemy's weak points. It is emphasized that in modern combat the attacker must maneuver swiftly, execute deep penetrations, withstand the enemy's fire pressure and counterattacks, and keep up a high rate of advance.

American regulations specify four basic phases of offensive actions: closing with the enemy, the attack proper (there can be two methods—from the line of march and prepared in advance), exploitation of success, and the pursuit. In the first two phases the battalion tactical group may act independently or as part of the brigade, and in the other phases usually as part of the brigade. In addition, it can conduct a reconnaissance in force, carry out raids into the enemy rear, deliver diversionary attacks, and perform feints.

The *closing* has the objective of achieving or restoring close contact with the enemy. It is believed that this phase of offensive actions will be characterized by swiftness and an absence of sufficient data on the enemy and will include the rapid forward movement of subunits in march formations and a deployment for the offensive. Under these conditions the battalion tactical group's combat formation usually is alined in a column with assignment of strong advance (and if necessary flank and rear) battle outposts. A reconnaissance platoon reinforced by a tank platoon usually is assigned to it. The advance battle outposts are up to 4 km from the main body; in the opinion of American military specialists, this will permit the commander to estimate the situation promptly, make a decision and deploy the main body outside the zone within which it can be engaged by weapons.

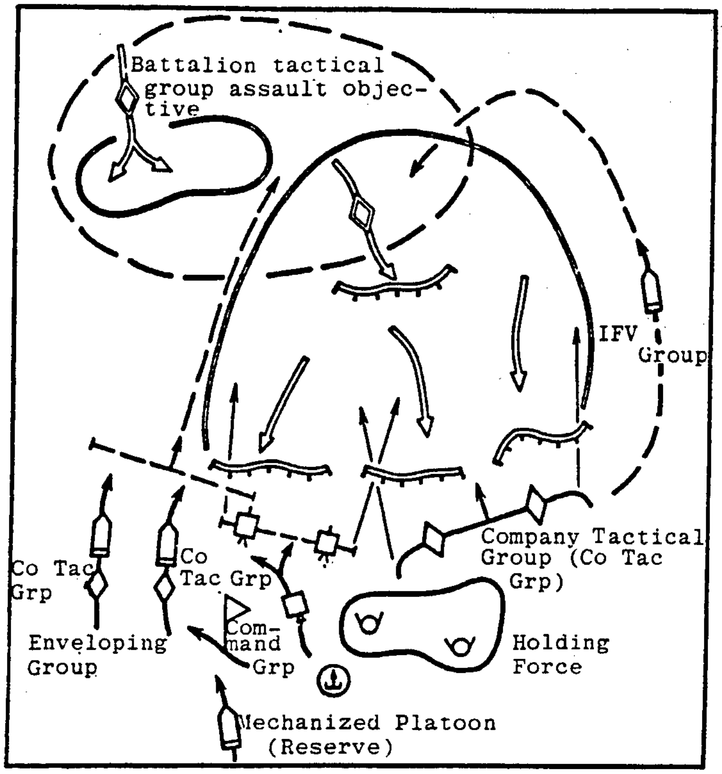

Fig. 1. Attack by balanced battalion tactical group against a weakly prepared enemy defense (variant)

U.S. Army regulations note that the *attack from the line of march is the basic method of combat actions under present-day conditions and can be conducted against an advancing enemy or an enemy defending poorly prepared positions. In the first instance the combat actions are classified as a meeting engagement in which the opposing sides will accomplish their missions by attacking. In the second instance the attack has a number of features which can affect alinement of the combat formation and the sequence of destroying enemy weapons and personnel. It is believed that within one hour enemy subunits which have assumed a hasty defense will be able to organize an effective fire plan (and antitank fire above all), lay antitank minefields on avenues of probable tank approach, and deploy a control system. Therefore the attackers' priority mission will be to neutralize enemy antitank weapons. An antitank company, supporting artillery subunits and fire support helicopters can be used to carry out the mission. In this case the battalion tactical group combat formation can be alined in a single echelon including a holding force and enveloping subunits. Up to a mechanized (tank) platoon is assigned to the reserve. The infantry usually assaults the enemy in dismounted formation at a distance of up to 300 m behind the tanks. Infantry fighting vehicles advance behind the attacking enemy (at an interval of up to 400 m) or make an envelopment (mobile IFV group) of enemy defensive positions with the objective of moving into his rear (Fig. 1).*

The battalion tactical group usually conducts a *deliberate assault* as part of a brigade against an enemy whose defense is prepared in the engineer sense and saturated with weapons, including antitank weapons. The American command's views are that it can take 12 hours or more to prepare such a defense. This method of offensive actions usually is organized in three phases: isolation of the enemy in a breakthrough sector, the breakthrough and annihilation of the defending enemy, and exploitation of success (Fig. 2). In the first phase it is planned to inflict damage on enemy weapons and personnel employing organic, attached and supporting weapons in a planned breakthrough sector and in contiguous sectors as well as in the depth to preclude the possibility of enemy subunits regrouping to the axis where the battalion tactical group's main efforts are concentrated. Defensive positions adjoining the breakthrough sector may be attacked to mislead the enemy regarding the axis of main attack. In the second phase primary emphasis is on determining the weakest spots in the enemy defense and isolating the sector where it is planned to execute the breakthrough, making passages in minefields and obstacles or searching for ways around, and conducting other measures supporting the battalion tactical group in a breakthrough of the planned defense sector and in expanding the breakthrough into the depth and toward the flanks. The third phase consists of taking individual objectives in the enemy defensive depth, disrupting his logistical support system and annihilating reserves.

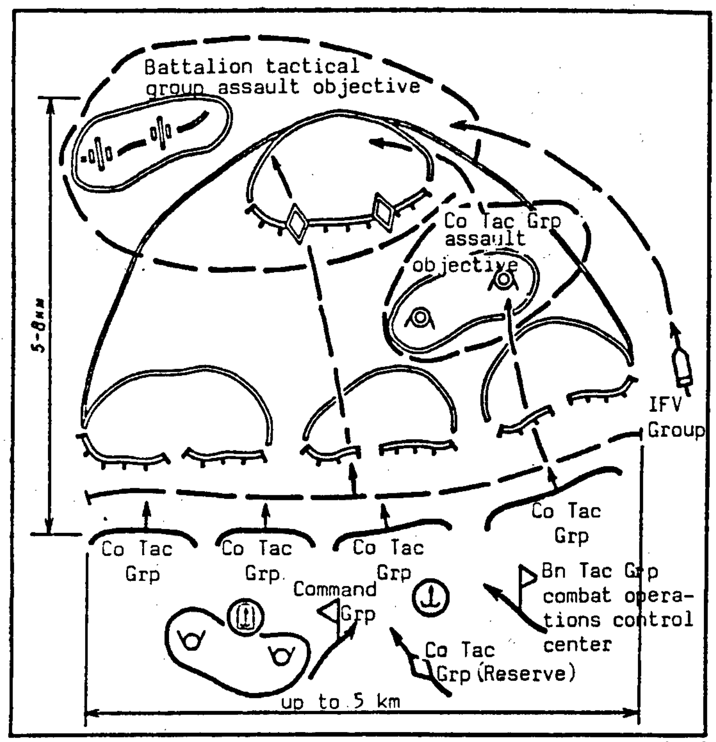

Fig. 2. Deliberate assault by mechanized battalion tactical group (variant)

Exploitation of success and the pursuit are those phases of offensive action carried out for the purpose of completing destruction of enemy weapons and personnel, disrupting his logistical support system, seizing key terrain sectors and achieving a high rate of advance.

The American command considers two variants of an assault on the enemy forward edge within the framework of the aforementioned basic methods of offensive: delivery of an attack on one axis and delivery of attacks on two or more converging axes. The assault may be carried out in dismounted formation with support of tanks and IFV's or using a mixed combat formation (in the following sequence: tanks, infantry, IFV's; or infantry, tanks, IFV's).

To ensure reliable control and organization of coordination with adjacent subunits, when the combat mission is assigned the battalion tactical group is given the assault objective, sector boundaries, zone and axis of attack, a forming-up place or line of departure for the attack, and a start line.

The assault objective (one or two) for the battalion tactical group can be designated at a distance of up to 10 km from the forward edge. American specialists include the destruction of enemy personnel and weapons and capture and holding of a favorable terrain sector in the depth of the enemy defense in the concept of an "objective".

The line of departure for the attack is designed for coordinating the time for the beginning of the attack. It must be defined according to clearly visible reference points on the terrain and as a rule must be perpendicular to the direction of main attack and be outside the range of fire of enemy antitank weapons and direct-fire weapons. The brigade commander designates a line of departure for the attack for the battalion tactical group.

The start line is assigned for subunits of the battalion tactical group in order to coordinate actions of forces and resources included in it. During an attack in dismounted formation the start line is chosen as close as possible to the forward edge of enemy defense, and in some cases may coincide with the line of departure for the attack (in an assault in IFV's).

The close envelopment, penetration and frontal attack are the basic forms of maneuver used by subunits of the battalion tactical group in the offensive.

Judging from foreign press reports, much attention is given to night offensive actions, which must be conducted with the very same intensity as during the day. It is planned to make extensive use of the method of infiltrating small mobile infantry groups through the defenders' combat formations, with their subsequent assembly in a designated area 2-3 km from the forward edge. Combat missions are assigned to subunits to a lesser depth so that they are accomplished by dawn and subunits can regroup and consolidate on captured lines.

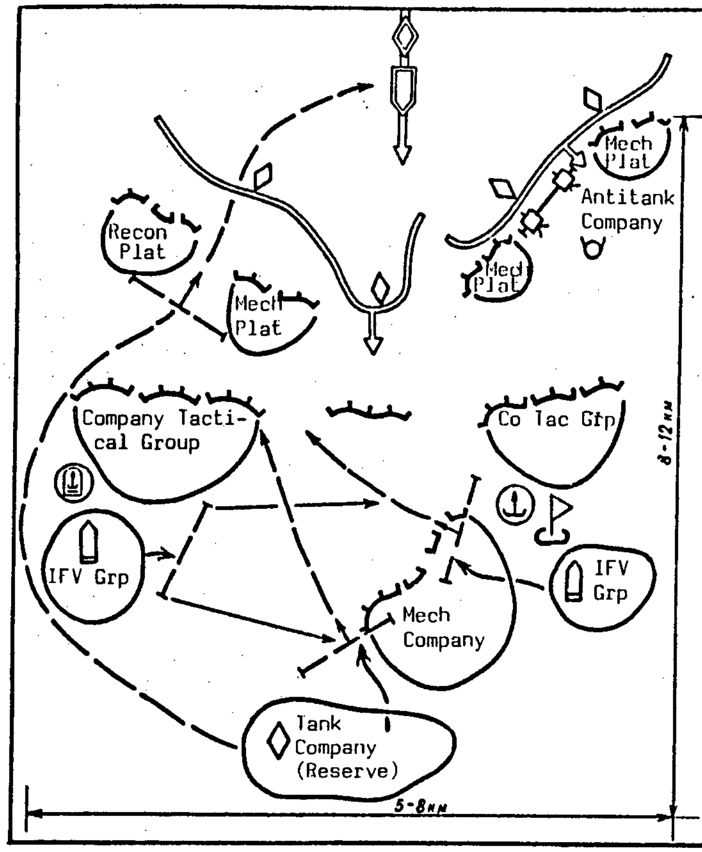

Fig. 3. Defense of an area by a mechanized battalion tactical group (variant)

The **defense** is a form of combat actions to which troops usually resort as a forced measure with the objective of disrupting an enemy offensive, winning time, concentrating forces on a chosen axis, establishing control over important terrain sectors, wearing down the enemy before assuming the offensive, and holding tactically important areas.

American regulations do not provide for a uniform method of conducting defensive actions. In one instance this may be a positional defense conducted exclusively to hold specific terrain sectors. The basic method of conducting it is by fire from occupied positions. In another instance it is a mobile defense based on a maneuver of forces and resources with the objective of disrupting combat formations and annihilating the advancing enemy. Predominance of a particular form depends in each specific instance on the combat mission, composition of available forces and resources, their combat effectiveness, and terrain conditions. For example, mechanized subunits of a defending grouping may organize centers of defense and strongpoints on rugged terrain and in populated points, while IFV's and tank subunits make up mobile elements.

The battalion tactical group usually conducts defensive combat actions as part of the brigade. In some cases it also can defend independently (on secondary axes, in the mountains, in the desert, in the jungle and so on).

When defending as part of the brigade the battalion tactical group may operate in the first echelon or be the brigade's combined-arms reserve. It may be assigned a defense area, combat position or strongpoint for the period of action. A defense area reaches 5-8 km in frontage and 8-12 km in depth. A mobile method of combat actions (Fig. 3) may be used in defending such an area. In this case the battalion tactical group's combat formation is alined in one or two echelons with assignment of battle outposts and a reserve.

In organizing the defense of a combat position 5-8 km in frontage and up to 5 km in depth, the battalion tactical group combat formation usually is alined in a single echelon (up to 3-4 company tactical groups) with assignment of a reserve consisting of up to a platoon (Fig. 4).

The primary objectives of actions by a battalion tactical group in defending a strongpoint are the following: hold terrain, inflict damage, prevent the advance of enemy tank subunits, and force the enemy to change the axis of main attack. A strongpoint is created in the brigade defense zone immediately on the forward edge or in the

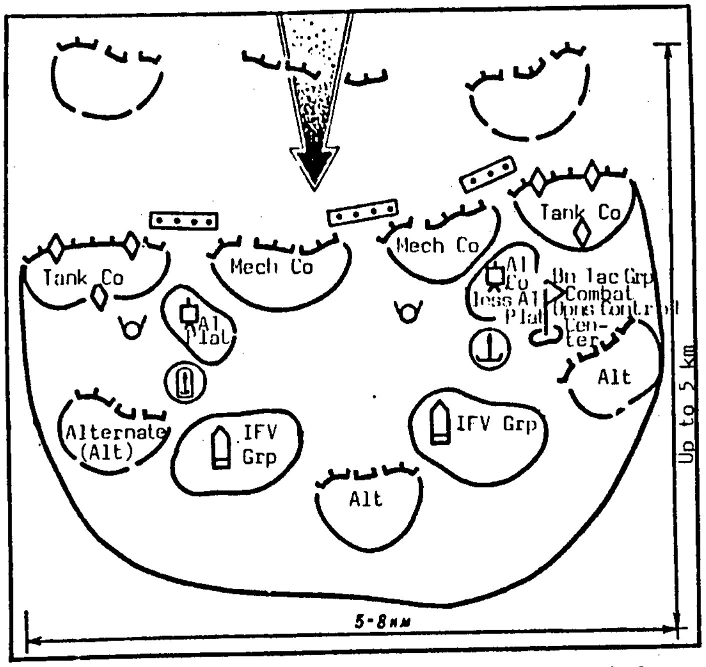

Fig. 4. Defense of combat position by balanced battalion tactical group (variant)

depth depending on the concept of combat actions. A battalion tactical group also can occupy a strongpoint when defending a populated point or an important key terrain sector. The distribution of subunits in defense of a strongpoint can be accomplished under two variants: all available forces and resources occupy positions within the strongpoint or mechanized subunits prepare defensive positions within the strongpoint and tank and antitank subunits and mobile IFV groups from mechanized subunits are situated outside the strongpoint (Fig. 5). The strongpoint is prepared in the engineer sense. American specialists' views are that under existing norms a battalion tactical group is capable of repelling an attack by up to two enemy motorized rifle (tank) regiments, which will require at least three days.

The plan for implementing basic principles of the "Air-Land Operation (Battle)" concept (and above all the "deep engagement") proposes employment of a battalion tactical group (usually a tank group) as a mobile tactical group, leaving it in the rear of the advancing enemy. To this end in the period of organizing a defense outside of contact with the enemy the brigade commander secretly moves the battalion tactical group to a preselected area situated between the positions of screening troops and the forward edge of defense and up to 10 km from it. A location is chosen away from the presumed axis of advance of the enemy main body. When a defensive fight is struck up and the enemy first echelon wedges into the brigade's main defense area the mobile tactical group counterattacks the the advancing enemy's flank and rear in an attempt to inflict damage on his second echelon and artillery subunits as well as to disorganize the logistical support system.

Control under modern combat conditions is regarded as one of the important elements in a commander's work to execute the assigned mission. The command and control system created in the battalion tactical group for the period of combat actions includes three basic components: control organs, communications forces and resources, and the control process proper (sequence and procedures of work by the commander and staff).

The basis of the command and control system consists of the battalion tactical group's control organs established on the basis of the group staff, signal platoon, and attached and service subunits. These organs include a command post as well as a command group (GK), combat operations control center (TsUBD) and a rear services control point (TPU) deployed on the basis of the command post.

And so the American command views the planned establishment of battalion tactical groups for the period of execution of combat missions as the optimum variant of tactical employment of mixed forces and resources of U.S. Army units in modern combat.

Footnotes

*For more detail on this concept see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 7, 1984, pp 29-35—Ed.

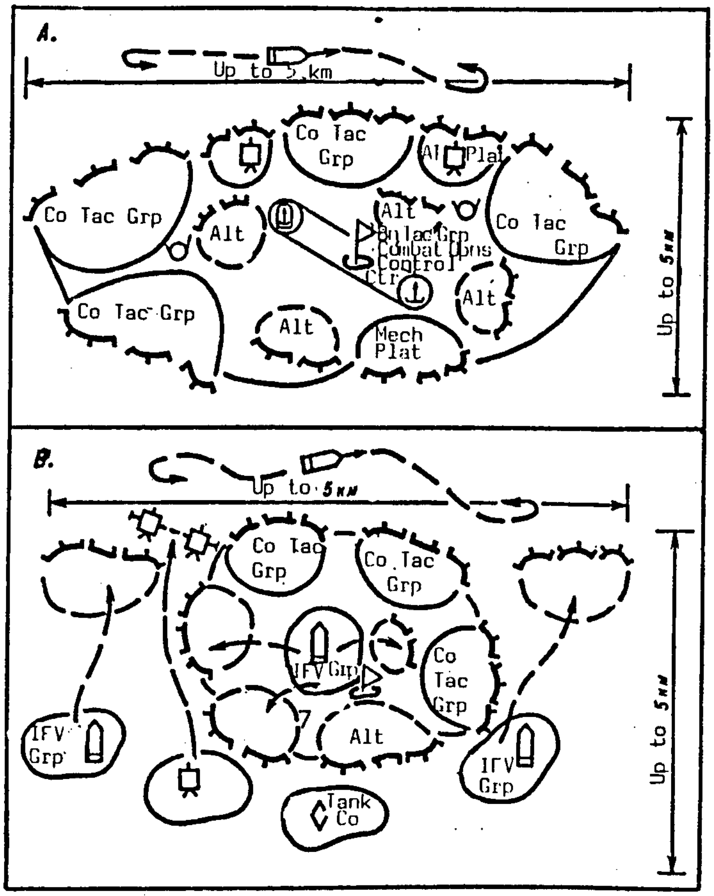

Fig. 5. Defense of strongpoint by mechanized battalion tactical group (variant):

Key:
A. All battalion tactical group subunits occupy positions within the strongpoint
B. Mechanized subunits occupy positions within and tank, antitank and mobile IFV groups outside the strongpoint

6904

Ground Surveillance Radars

18010065c Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 23-29

[Article by Lt Col V. Savrasov]

[Text] Command authorities of capitalist country armies regard battlefield surveillance as a very important kind of support to ground combat actions and place high demands on it with respect to completeness, validity and promptness of collecting data on the enemy. Foreign military specialists believe that technical resources (including radars) play a prominent role in tactical intelligence.

In accordance with the NATO classification based on detection range of ground targets, ground surveillance radars are divided into four basic classes: long range (20 km or more), medium range (up to 20 km), short range (up to 10 km) and close range (up to 4 km). All of these radars are in the inventory of reconnaissance and other subunits and are intended to accomplish the following primary missions: detecting and determining the coordinates of moving and stationary ground targets, detecting helicopters (including hovering helicopters) and low-flying aircraft, performing surveillance of bridges and road intersections, providing security for troop and combat equipment locations, detecting enemy artillery positions and adjusting friendly artillery and mortar fire.

Western specialists believe that to successfully accomplish these missions under various conditions of tactical employment, especially at night and with poor visibility, these technical resources must satisfy a number of requirements: provide the necessary detection range and accuracy in determining target coordinates, have sufficient operating reliability, be simple to maintain, have small size and weight, and possess antijam capability, concealment and electromagnetic compatibility.

The required maximuim detection range of ground surveillance radars is determined basically by the standard reconnaissance zone for tactical subunits. For example,

according to standards adopted by NATO, the depth and frontage of a company reconnaissance zone is 8x5 km, for a battalion it is 15x10 km and for a brigade it is 75x30 km. It is noted that ground surveillance radars in the inventory of army subunits of NATO countries basically satisfy these standards and provide surveillance to the required depth. For close range, short range and in some cases medium range radars the minimum detection range also is important along with the maximum detection range. This is determined chiefly by the radar's operating principles; for sets operating in a continuous emission mode (such as the AN/PPS-9, AN/PPS-10 and AN/PPS-11) it is essentially 0 m, and for pulse radars (AN/PPS-5, AN/PPS-6 and others) it is 40-60 m.

The accuracy of modern ground surveillance radars in determining coordinates is within units and tens of meters; foreign specialists believe this is fully acceptable when searching for moving targets.

The reliability of these radars is constantly improving. While the first models which became operational in the early 1950's had a mean time between failures of no more than 40-50 hours, according to foreign press data it is presently 8,000-9,000 hours for such radars as the AN/PPS-17, AN/PPS-18 and RATAC-S. The sharp increase in reliability became possible because of the extensive use of transistors, integrated circuits, high-strength materials and effective power sources.

Simplicity in maintaining modern ground surveillance radars is achieved basically by using microprocessor technology in their designs, reducing the number of operating and tuning controls, and reducing weight and size. The presence of computers permits complete automation of the processes of search, detection, identification, coordinate determination and display of detected targets.

The size and weight of ground surveillance radars are important descriptors, especially for models used in small subunits and attended by one or two operators. The weight of modern radars has been reduced 2-3 times in comparison with similar models developed in the 1950's. This was done chiefly by improving the level of design technology and using microelectronic components.

NATO military specialists emphasize that antijam capability is one of the most important requirements placed on surveillance and acquisition radars. The enemy's proximity, deliberate jamming, high levels of natural interference from terrain folds, vegetation, rain and snow, as well as other factors require the necessary appropriate means and methods of protection. The simplest protection arrangements are used (manual and automatic gain control, logarithmic amplifiers, small time-constant circuits and so on), however, because of weight-size limitations. Simple circuits for moving target selection (SDTs) and false-alarm threshold optimization also are used in radars based on microelectronic components. In addition, some models use a carrier frequency change.

Requirements for ensuring concealed operation of ground surveillance radars and for their electromagnetic compatibility are closely interrelated and are rather difficult to implement. Inasmuch as they are active means (they emit electromagnetic energy), they are detected at distances usually exceeding their operating range.

The foreign press notes that the majority of ground surveillance radars, and short range and close range radars above all, have simplified circuit solutions and designs leading to the appearance of increased side lobe levels in radiation patterns. The rather strong side emissions arising because of this and the constantly growing saturation of troop subunits with such radars (for example, the U.S. infantry division has some 60) dictate the need for their planned use. NATO military specialists see a solution to this problem in precise regulation of the operation of reconnaissance equipment by time and sectors, their proper disposition on the terrain, and sometimes also a reduction in radiated power. To ensure concealment it is also deemed necessary to use radars briefly, and primarily on the most important targets.

The overwhelming majority of ground surveillance radars in the inventory of NATO ground forces operate in a pulse or continuous wave mode in the centimeter frequency band. The Doppler method is used for detecting and selecting moving targets. Operator target selection is by ear (through headsets) or visually (according to needle instruments, indicator lights or displays). The direction to the target in azimuth corresponds to the maximum level of the received signal. Distance to target is determined by the time it takes the signal to pass to it and back, movement rate is determined according to the Doppler frequency of the received signal, and type of target is determined by the nature of the sound.

According to foreign press data, the United States and France are the most active in developing ground surveillance radars. Great Britain, Italy, Israel, Denmark, Sweden and the FRG also have sets of their own manufacture. Armies of other capitalist states basically have American, French or British models in the inventory.

At the present time **long range ground surveillance radars** are being produced in France, the FRG and Israel (see table). They have large weight-size characteristics and so are mounted on motor vehicles (mobile version) or on the ground (far from the forward edge), while the French Orphee is installed in the Kibitz tethered drone created by the West German firm of Dornier.

One of the latest developments is the Israeli EL/M-2121 radar, manufactured since the early 1980's by Elta Electronics Industries. It has a modular design. Gear and

Type, Developing country, Year operational	Detection Range, m		Accuracy in Determining Coordinates		Operating Frequency, MHz	Total Weight, kg	Output, watts*	Set-up Time, min
	Person	Vehicle (Tank)	Range, m	Azimuth, °				
1	2	3	4	5	6	7	8	9
Long Range								
DR-MT-1A, -2A, France, 1958	15 000	30 000	±20	±0,3	9400	3400	40 000/—	45
Orphee, France	—	60 000	•	•	•	150	•	•
Stentor, France	30 000	60 000	±20	±0,8	9400—9600	500	60 000/—	•
RATAC-S, FRG, 1987	•	35 000	±10	•	9400—9600	•	•	•
EL/M-2121, Israel	20 000	40 000	±15	±0,1—0,2	•	•	•	•
Medium Range								
AN/TPS-25, USA, 1959	4500	18 300	±(25—75)	±0,14	9375	1350	43 000/—	15—45
AN/TPS-33, USA, 1960	6500	18 200	±(25—75)	±1,3	9375	120	7000/—	10—15
RATAC (DR-PC-1A), France, FRG, 1972	10 000	20 000	±(10—20)	±0,6	9400—9600	250	8000/—	5
Rasit-72, France, 1977	14 000	20 000	±10	±0,6	9500—9700	50—70	3000/—	3
EL/2108, Israel	4000	12 000	•	•	In 3-cm band	40	•	5
Short Range								
AN/PPS-4, USA, 1957	1500	7000	25	±0,6	8000—9400	45	500/—	10
AN/PPS-5, USA, 1967	5000	10 000	20	±0,6	16 000—16 500	41,5	1000/—	10
DR-PT-2A, (Rasura), France, 1978	4000	7000	25	±1	9400	60	2500/—	•
Rasura-2, France, 1978	5000	8000	25	±1	8000—10 000	24	200/—	4
DR-VT-1, (Repace), France	1500	5000	25	±0,6	16 000	20	2/—	3
GS No 14 Mk 1, UK, 1967	4000	10 000	±25	±0,8	10 000—10 900	12,3	3000	3—5
RQT-10X (Sentinel), Italy, 1975	•	5000	•	•	•	8,5	•	2
Close Range								
AN/PPS-6, USA, 1965	1500	2000	30—40	±3	9000—9500	7	120/—	5
AN/PPS-9, USA	1500	3000	8	±5	9250	5,9	•	3
AN/PPS-10, USA	1500	3000	10	±1,2	In 3-cm band	6,5	•	3
AN/PPS-11, USA, 1970	500	1000	8	±2,5	9250	4,5	—/0,06	1

Key:
*Output in pulse mode given in numerator; output in continuous-wave mode in denominator

1	2	3	4	5	6	7	8	9
AN/PPS-15, USA, 1973	1500	3000	10	±1,2	In 3-cm band	8,2	—/0,06	2—3
AN/PPS-17, USA	1500	3000	.	.	9000—9500	12,3	.	.
AN/PPS-18, USA	1500	3000	.	.	9250	15,8	4,5/—	.
DR-PT-4B (Oliphant-1), France, 1966	1600	2300	30—50	±3	10 000	18	.	1
AN/PPS-12, USA, 1971	1500	3000	8	±2,5	.	0,7	.	.
DR-PT-6 (Oliphant-2), France, 1972	1800	2500	50	±1—2	15 350—17 250	13	0.04/—	1
CS No 18 Mk 1 (Prowler), UK, 1976	1500	2000	.	.	15 350—17 250	11,5	0.25/0,025	1
R-2000, USA	.	3000	25	.	9000—9500	10	5/—	2
UAP-40301 (Isidor), Sweden, 1977	300	2000	.	.	10 500	2,5	—/0,01	1
RQT-9X (Sentinel), Italy, 1968	600	3800	65	±2	In 3-cm band	18	—/0,04	3
RB-12 & -12A, France	2000	4000	10	±1,5	In 2-cm band	.	.	.

antenna are installed in a standard hut which can be accommodated in a vehicle body (Fig. 1 [figure not reproduced]) or set up on the ground. A microprocessor controls station operation. A television screen is mounted in front of the operator. There is protection against enemy EW capabilities and a built-in system for checking the operating capacity of individual radar components.

The French long range Stentor ground surveillance radar (Fig. 2 [figure not reproduced]) usually is set up on elevated terrain. In addition to ground targets, it detects helicopters hovering or flying low over the ground.

Medium range ground surveillance radars are basically represented by American and French models. The RATAC (DR-PC-1A) radar of joint Franco-West German development also has been adopted by the U.S. Army (it was designated the AN/TPS-58). The radar is intended both for reconnaissance of moving ground targets as well as for adjusting artillery fire (based on shellbursts) and can be connected to various automated systems. It is used in a portable version or is accommodated on a means of transportation (APC). In the latter case it includes an antenna with transceiver, radar signal processing unit, operator console with two azimuth-range indicators, aural indicator (loudspeaker), digital display unit with coordinate grid for reproducing detected targets (it can be connected to the operator console), power transformer and automatic plotting board.

The French Rasit-72 (Fig. 3 [figure not reproduced]), which operates in a pulse mode, has a modular design and is distinguished by high reliability, is regarded as up to date among portable medium range radars.

A radar of this class also has been created in Israel (designated the EL/M-2108). It consists of an antenna, transmitter, receiver and control console remotable to a distance of up to 100 m. The overall weight of antenna, transmitter and receiver is 25 kg, and the control unit weighs 15 kg. The radar gear is carried by a team of two persons and set-up time is no more than 5 minutes. The operating frequency can be retuned to improve antijam capability.

Short range ground surveillance radars have become widespread in NATO countries. For example, the American AN/PPS-5 radar (Fig. 4 [figure not reproduced]) and its improved modification AN/PPS-5B have been produced in a quantity of over 2,000 sets. The radars are equipped with remote control consoles and have visual and aural target indication. Having been adopted in 1967, they were actively used during the U.S. aggression in Southeast Asia for surveillance of troop movements in the forward area. The sets are pulse-Doppler in operating principle, are of modular design and are transported by a team of three persons.

Ground forces of France, the FRG, the Netherlands, Denmark, Italy and Spain use the French Rasura (DR-PT-1A, -2A and -3A) radar. It can be mounted on a

tripod or installed in a light vehicle. The set has a remote control console with visual and aural target indication. One of its features is the possibility of identifying targets using the Arabel radar transponder.

The British GS No 14 Mk 1 short range ground surveillance radar is in the inventory of British Army tank regiments, mechanized battalions, and artillery instrument reconnaissance subunits. It is installed primarily in Spartan reconnaissance APC's (Fig. 5 [figure not reproduced]). It is noncoherent pulse-Doppler in operating principle and has a remote control unit (to a distance of up to 20 m). The indicator is made with light-emitting diodes. Target range is read from an electronic digital indicator and the azimuth and elevation from a drum-type counter. When the radar is set up on the ground its antenna is fastened on a tripod. The entire set (weighing around 32 kg) is transported by two soldiers and made combat-ready in 3 minutes.

In addition to American and French models, the Italian Army uses the domestically developed Sentinel RQT-10X radar with continuous-wave frequency modulated emission. A receiver, transmitter and antenna are joined in one unit. An external control panel can be located up to 30 m away from the main gear. Search for and detection of a target is by an operator by ear, and range and azimuth readings are from a digital indicator and a scale on the tripod respectively.

Close range ground surveillance radars, used primarily by small subunits, are the largest group.

A typical representative of American radars in this class is the AN/PPS-11 by RCA. It has a coherent Doppler operating principle and operates in a continuous-wave mode with phase modulation. That mode of emission improves antijam capability and concealment of operation. Radar assemblies are made from solid-state elements. The radar is powered by a portable nickel-cadmium storage battery (weighing around 1 kg) fastened on a belt. The antenna is built into the radar case. A modification of this set equipped with devices for automatic scanning and for signaling the appearance of a target was designated the AN/PPS-12. Its operating range was tripled in comparison with the base version and its weight was reduced by 2.5 kg.

The U.S. Army has had the close range AN/PPS-15A ground surveillance radar (Fig. 6 [figure not reproduced]) in the inventory since 1973. The most up-to-date of French close range sets is considered to be the Oliphant-2 (Fig. 7 [figure not reproduced]) being used in French Army subunits and in the inventory of the armies of Great Britain, the FRG and Ireland. It is a pulse-Doppler coherent radar in operating principle. Target indication is by ear and range determination to targets is by digital counter. A feature of the radar is increased operating concealment because of the low radiated power level.

The portable GS No 18 Mk 1 Prowler radar was created in Great Britain based on the Oliphant-2. It operates in a continuous-wave and pulse mode. The continuous-wave mode is used for target search and the pulse mode for determining distance to the target and direction of movement. The distance reading is from an indicator scale made from light-emitting diodes. Made from semiconductor instruments, the radar is fastened to the operator's chest and is quickly placed in a combat-ready condition.

A distinguishing feature of the Swedish UAP-4031 Isidor radar is the possibility of coupling several transceiver units with one control panel. It uses a combination method of target indication. To ensure concealment of operation and electromagnetic compatibility the sounding beam formed by the antenna is narrow with a low sidelobe level. The radar was developed and is being produced by Ericsson.

All ground surveillance radars in the inventory were created basically during the 1960's and 1970's. The RATAC-S (Fig. 8 [figure not reproduced]) developed by the West German firm of Standard Elektrik Lorenz is among the latest radar models. It is a pulse-Doppler radar with coherent emission. A monopulse method is used to determine target coordinates.

Structurally the set consists of two units—radio frequency (antenna, transmitter and receiver) and control (console with display, processor and electronic signal processing system)—which can be separated by a distance of up to 50 m when situated on the ground. To increase target detection range and for maximum use of the terrain's concealing capabilities the radar antenna is fastened to a hydraulic platform which elevates to a height of up to 12 m.

Features of the RATAC-S radar compared with preceding models of this class are higher accuracy of determining target coordinates (up to 10 m), better operating reliability (mean time between failures at least 1,000 hours) and relatively low production cost.

The set has five operating modes: automatic and manual target search up to 35 km in range, manual and automatic target tracking, automatic target tracking with movement route display. In addition to observation of ground targets the radar gear permits detecting helicopters and adjusting artillery fire. The obsolete AN/TPS-33 and Rasura radars will be replaced by this radar in the FRG Army.

Judging from foreign press reports, at the present time the United States, France and other capitalist countries are conducting active R&D to develop new ground surveillance radars with a high level of automation, higher antijam capability and higher operating reliability. Preference is given to combination systems in which the radar's surveillance of ground targets is supplemented by data from other sensors.

In particular, such equipment is being actively created in the United States under the EMS (Elevating Multisensor System) program. Several versions of ground target acquisition systems on elevating platforms are being developed within the scope of this program. Radars of these systems are to have a detection range of armored targets up to 20 km and of a person up to 8 km. It is planned to fasten the radar to a platform which can be elevated to a height of around 20 m using a telescopic mast. In addition to the set, the platform will accommodate a laser rangefinder-target designator, TV camera, IR sensor and other detection and surveillance devices. To conceal the system's location it is planned to use the radar against the most important targets under adverse weather conditions when it is impossible to perform effective reconnaissance with other (passive) system sensors. It is planned to control the operation of all sensors using a small computer. In the assessment of American military experts, U.S. Army requirements are for 560 sets of such systems. It is also planned to use similar design solutions in building the BMS battlefield acquisition and management system and LRAT long range armored target acquisition system. It is noted that a new generation of ground surveillance radars (systems) with higher capabilities than existing radars will become operational in the ground forces as a result of the completion of those projects.

6904

U.S. Armored (Mechanized) Division Tank Battalion

18010065d Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) p 30

[Article by Lt Col I. Aleksandrov]

[Text] The American command places great emphasis on improving the organization and establishment of units and subunits in armored (mechanized) divisions within the framework of an ongoing Army modernization. The foreign press reports that at the present time tank battalions of the regular Army and reserve components are converting to a new organization and establishment as modern types of weapons and combat equipment come to the troops. It is noted that the principal features of the new battalion organization are the presence of four tank companies (previously there were three) of somewhat lesser composition and fewer personnel, and an increase in the number of personnel and subunits in the headquarters company. American military specialists believe that these changes should give the tank battalion greater independence on the battlefield and an opportunity to assault up to two objectives simultaneously. Organizationally a tank battalion consists of a headquarters and five companies: a headquarters company and four tank companies.

The *headquarters* (27 persons) organizes control of the battalion's organic and attached subunits in combat and their combat and logistical support. In peacetime it plans and conducts combat training, accounts for personnel, and provides logistical support of battalion subunits.

The *headquarters company* (252) includes a headquarters section (13, two M1 Abrams tanks) and six platoons: reconnaissance (30, platoon headquarters in two M3 combat reconnaissance vehicles and two reconnaissance sections each with two M3 combat reconnaissance vehicles), mortar platoon (36, headquarters and two mortar sections, each with one M577A1 command and staff vehicle and three 106.7-mm self-propelled mortars), communications platoon (13, headquarters and two sections—radio communications and wire communications), medical (23, headquarters, aid station, and evacuation section, the latter with six M113A1 APC's), support platoon (54, headquarters in an M577A1 command and staff vehicle and three sections—transport, fuel and mess), maintenance platoon (53, headquarters and seven sections—administrative, repair, maintenance, and four tank company maintenance). The headquarters and headquarters company have a total of 279 persons, 2 M1 Abrams tanks, 6 M3 combat reconnaissance vehicles, 6 106.7-mm self-propelled mortars, 8 M577A1 command and staff vehicles and 11 M113A1 APC's.

The *tank company* (61) includes a command element (3), company headquarters and three tank platoons. The company headquarters (10) has two sections: headquarters (5, two M1 Abrams tanks) and supply (5, two vehicles). Each tank platoon has 16 persons and four M1 tanks. The company has a total of 14 M1 Abrams tanks (under the old organization it had 17).

On the whole, judging from foreign press reports, the tank battalion has 523 persons including 41 officers as well as 58 M1 Abrams tanks (previously 54), 6 M3 combat reconnaissance vehicles, 6 106.7-mm self-propelled mortars, 8 M577A1 command and staff vehicles, 11 M113A1 APC's, around 90 motor vehicles, over 170 radios and other materiel.

American regulations note that the tank battalion usually fights as part of the brigade, operating in its first or second echelon on the main axis and more rarely on a secondary axis, in the reserve or as part of screening troops. In some cases it is capable of performing an independent mission. In combat it is planned to use it as the basis in forming battalion tactical groups made up of two or three tank companies, one or two mechanized companies, and reconnaissance, engineer, artillery, air defense and other reinforcing and supporting subunits.

According to foreign press reports the frontage of tank battalion advance can be 3 km or more and in some cases even up to 5 km. It is assigned an immediate mission (objective) to a depth of 4-5 km and a subsequent mission to a depth of from 8 to 10 km. A tank battalion

operating in the brigade first echelon may aline its combat formation in one, two or three echelons, with echelon right or left, or with one up or two up.

On defense the battalion is assigned a defense area 3-5 km wide and deep. The combat formation is alined in two echelons, and second echelon subunits are given deployment and counterattack lines. Battle outpost positions are organized up to 3 km from the battalion's forward edge of defense (in the absence of immediate contact with the enemy).

6904

Norwegian Air Force

18010065e Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 31-36

[Article by Col V. Artemyev]

[Text] The basis of Norwegian military policy ("security policy") is participation in NATO. The immediate contribution of Norway, which holds one of the first places in NATO in military expenditures per capita, helps build up this imperialist bloc's military potential to a certain extent. In supporting decisions of the Washington NATO Council session (May 1978), Norway pledged to increase its military expenditures by at least three percent each year right up until the beginning of the 1990's. It is taking a more and more active part in the work of various North Atlantic Alliance organs including the Nuclear Planning Group.

The bloc's joint armed forces hold regular maneuvers on Norwegian territory. Its infrastructure has been prepared for accepting allied forces and for their employment in case of so-called crisis situations. In particular they have been given the opportunity of using eight air bases as well as of stockpiling heavy weapons in peacetime for a U.S. Marine brigade earmarked for movement to Northern Norway.

Omega and LORAN-C radio navigation stations and other facilities serving American nuclear-powered submarines patrolling the North Atlantic are located on the country's territory, as are E-3A AWACS aircraft of NATO's AWACS Command.

The government of Norway strictly carries out North Atlantic Alliance leadership decisions on further developing the national armed forces, and above all outfitting them with the latest models of weaponry. There is great emphasis on the Air Force, which along with the military aviation of Denmark and the FRG comprises the basis of NATO's joint air forces in the North European Theater.

Based on data published in the foreign press, the missions, organization, composition, combat training and direction of development of the Norwegian Air Force are given below.

Missions, organization and fighting strength. The foreign press notes that the Norwegian Air Force is called upon to accomplish the following primary missions: striking enemy ground and naval targets in the tactical and operational-tactical depth, giving air support to ground and naval forces during their offensive and defensive actions, conducting aerial reconnaissance of ground and naval targets, covering major administrative centers and troop groupings against air attack, and moving troops and cargoes by air.

Special missions are assigned to the Norwegian Air Force in a threat period when reinforcing troops are expected to move from the United States, Great Britain, Canada and other NATO countries to the North European Theater. In this connection it must keep airfields in constant readiness to receive allied aviation and create necessary stores of aviation fuel and other supplies at the airfields.

There was a reorganization in the Norwegian Armed Forces in 1970 which was primarily a unification of all branches of the armed forces under a common leadership (Armed Forces High Command). A chief inspector was appointed in place of the Air Force CIC; he became part of the Armed Forces High Command and was made directly subordinate to the Armed Forces CIC. He is a special adviser of the CIC in questions of the Air Force's tactical employment.

The chief inspector of the Air Force is responsible for unit and subunit combat readiness, personnel training and flight safety, and he monitors Air Force development and outfitting. He exercises leadership of the Air Force through his staff, which includes appropriate departments and inspectorates (personnel, combat training and so on).

Organizationally the Air Force consists of two regional commands (in Northern and Southern Norway) and a rear command. The latter is a component part of the Armed Forces rear and in peacetime is subordinate to the minister of defense; therefore questions of Air Force logistical support are resolved by the chief inspector through the CIC of the Norwegian Armed Forces.

In wartime the regional command is the basic large strategic formation of NATO air forces in the North European Theater. Its control organs are combined with control organs of the corresponding command of the bloc's joint air forces. In peacetime it is made up only of Norwegian Air Force units and subunits and is subordinate to the CIC of the Norwegian Armed Forces in the region. The command authority includes units and subunits with various missions, including aviation units and subunits: the main base, the base and the squadron.

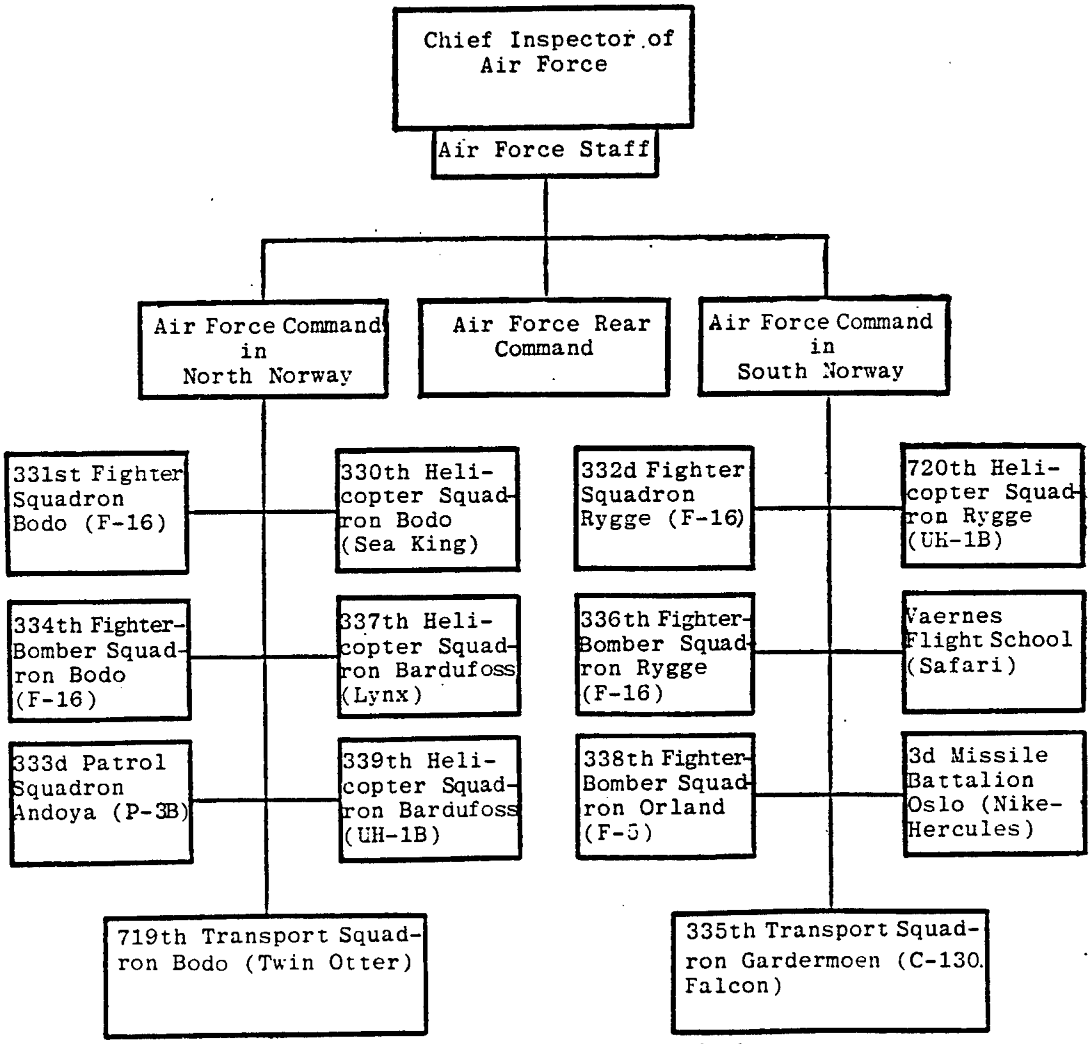

Fig. 1. Norwegian Air Force organization

The main air base is an aviation unit which incorporates both combat as well as support subunits stationed at one airfield. It is given the name of this airfield. It may include several air squadrons and all necessary subunits of administrative and logistical services. The main air base commander is responsible for logistical support of the squadrons and for personnel training.

The air base is intended for use in wartime and has a limited number of support subunits necessary for keeping it in a state of readiness for receiving combat units.

The air squadron includes several flights (detachments) and usually has aircraft (helicopters) of the same type in its order of battle. In peacetime the squadron commander is subordinate directly to the CIC of the regional command air force for operational affairs and to the air base commander for administrative affairs.

The organizational structure of the Norwegian Air Force is shown in more detail in Fig. 1.

The *Air Force Command in North Norway* (headquarters at Bodo) includes seven air squadrons including a fighter squadron (331st), fighter-bomber squadron (334th), transport squadron (719th), patrol squadron (333d) and three helicopter squadrons (330th, 337th and 339th) as well as several AAA battalions.

The 331st Fighter Squadron (Bodo Air Base) has 18 F-16 aircraft equipped with AIM-9B Sidewinder air-to-air guided missiles. Even in peacetime it is operationally subordinate to NATO's joint air forces and accomplishes air defense missions. Its crews are constantly on alert duty and intercept airborne targets over the North Atlantic.

The 334th Fighter-Bomber Squadron (Bodo) has F-16 aircraft (18 under the T/O&E) equipped with various weapons for delivering strikes against ground targets. When the Penguin-3 air-to-ship guided missiles come

into the inventory the squadron also will operate against waterborne targets. It can simultaneously accomplish air defense missions.

The 333d Patrol Squadron (Andoya) has seven P-3B Orion land-based patrol aircraft. Its mission is to detect and at the same time destroy surface combatants and submarines in sea areas adjoining national territory. In peacetime it is used to conduct aerial reconnaissance over the sea; the data collected is passed to appropriate staffs of the armed forces of Norway and other NATO countries.

The 719th Transport Squadron (Bodo) handles air movements for all branches of the national armed forces. It has several DHC-6 Twin Otter military transport aircraft and two UH-1B search-and-rescue helicopters.

The 330th Helicopter Squadron has ten Sea King search-and-rescue helicopters. Its headquarters and Flight A (four helicopters) are located at Bodo Air Base. The other flights (B, C and D, each with two helicopters) perform duty at the Banak, Orland and Sola airfields respectively.

The 337th (6 Lynx) and 339th (15 UH-1B) helicopter squadrons are stationed at Bardufoss Air Base. The 337th performs security missions and search-and-rescue operations in areas of oil and gas producing complexes and fishing areas. The 339th operates in the interests of the ground forces by making tactical air movements of personnel and cargoes.

The airfields of Bodo, Andoya and Bardufoss are screened by AAA batteries (an average of three batteries for each airfield). A AAA battery includes four weapon platoons and an acquisition and target designation radar. Each weapon platoon has Bofors L70 or L60 antiaircraft guns and two 12.7-mm machineguns.

The *Air Force Command in South Norway* (headquarters at Jatta) includes two fighter-bomber squadrons (336th and 338th), one fighter squadron (332d), one transport squadron (335th), one helicopter squadron (720th), a Nike-Hercules battalion and AAA subunits.

The 336th Fighter-Bomber Squadron (Rygge Air Base) is equipped with F-16's. As a reserve it has several obsolete F-5A and F-5B tactical fighters, with which the 338th Fighter-Bomber Squadron (Orland) is equipped. The basic mission of these subunits is to strike ground and naval targets using aerial bombs as well as air-to-surface guided missiles. In particular, the Bullpup guided missile is considered the principal weapon of the 338th Fighter-Bomber Squadron. The foreign press has reported that crews of this squadron will begin to retrain in F-16's in late 1988 (another 24 aircraft of this type have been ordered to re-equip the squadron as well as to make up for losses of F-16 fighters in other squadrons).

The 332d Fighter Squadron (Rygge) accomplishes air defense missions. At the same time it is used as the basis for retraining flight personnel in the F-16. Therefore it has the two-seat F-16B trainers in addition to single-seat F-16A combat aircraft.

The 335th Transport Squadron (Gardermoen) has six C-130H Hercules military transports and several special-purpose aircraft used for calibrating ground radiotechnical equipment, conducting EW and transporting higher command personnel as well as highly placed foreign guests.

The 720th Helicopter Squadron (Rygge) has UH-1B helicopters. It is intended for accomplishing missions in the interests of ground forces and it takes part in performing search-and-rescue operations.

A Nike-Hercules battalion (headquarters at Oslo) includes four batteries (nine launchers each) located around the capital. In addition the Rygge, Gardermoen, Lista, Vaernes, Sola and Orland airfields are screened by AAA batteries (an average of four at each airfield).

The western press notes that on the whole all of Norway's air defense forces and resources organizationally are part of NATO's northern air defense zone and are distributed between air defense sectors North and South, the boundaries of which coincide with boundaries of regional commands. The zone operations center is located at Kolsas.

Immediate control of fighter-interceptors and the surface to air missile systems is exercised by the command authority of air defense sectors through control and warning centers of the NADGE system, which accomplishes missions of detecting and tracking airborne targets, vectoring fighters to them, collecting data on the air situation and passing the data to sector and zone operations centers.

Two or three observation and warning posts function for every control and warning center; they organize the collection of data on the air situation and the data's transmission to the control and warning center. The foreign press reports that several long-range radar detection posts also are deployed on Norwegian territory, which considerably improves the capabilities of the entire system to detect airborne targets and vector active air defense resources to them.

The *Air Force rear command* (headquarters at Kjeller) handles the logistical support of all Air Force units and subunits. Central and regional control agencies as well as supply units are subordinate to it. Immediate direction and supervision over the activity of logistics subunits are exercised by the Air Force CIC's in Northern and Southern Norway through the rear organs of their staffs. The command has around 1,000 persons, of whom almost 50 percent work at repair enterprises.

A significant reorganization of the logistical support system is being carried out in connection with introduction of F-16 aircraft to the Air Force inventory. For example, an automated system for controlling logistics units and subunits is being deployed for the purpose of rapidly exchanging information as well as coordinating deliveries of spare parts and hardware.

The western press notes that at the present time the Norwegian Air Force has almost 10,000 persons, not counting 2,500 reservists serving in air defense subunits of the Home Guard (a voluntary militarized organization), around 100 combat aircraft, 13 military transports, 15 trainers as well as up to 60 helicopters. In addition the Air Force has 36 Nike-Hercules launchers and 96 L60 and L70 40-mm antiaircraft guns.

Personnel training and Air Force unit and subunit combat training.

Personnel training for the Norwegian Air Force is accomplished at so-called basic training military schools and in higher military educational institutions.

Flight and technical personnel as well as specialists for air defense units and various services are trained in the first type of schools, which include the Vaernes Flight School, a technical training center at Kjeller and a command training center at Stavern. The latter includes an Air Force command school, Air Force officers' school, air defense school and course training section. Qualifications are improved and a higher education is obtained at the officers' school in Stavern, at the Air Force military school in Trondheim and at the Armed Forces staff school in Oslo.

Special emphasis is placed on training flight personnel. This training begins in the aforementioned Vaernes Flight School, where young pilots are selected and given initial training. The school's mission is to identify candidates' abilities for flight operations and winnow out incompetents in the earliest possible stage of training. The foreign press reported with regard to this that each year this school receives up to 600 applications. Screening tests held three times a year include a psychological check (at which up to 50-60 percent of the candidates are winnowed out) as well as a test flight in an aircraft with the objective of determining fitness for flight work. The persons selected take a nine-month course of combined-arms training and basic training (with 25 flying hours) in an MFI-15 Safari light piston-engine aircraft. The dropout rate also is around 50 percent in this phase.

Those who successfully complete this phase of training (up to 50 persons) are sent to the United States for further training. There over 200 hours are set aside for each of them for practical flight training in accordance with the training profile—jet, transport, patrol aviation. Cadets who have finished training in the United States return to Norway and complete their education. Then, having received the initial officer rank, they are sent to line units where each one has to fly around 180 hours in accordance with annual combat training plans. Within the scope of this flying time the person is obligated to perform various exercises including real bombing or firing against airborne targets. Pilots are given the qualification "fully combat ready" or "restricted combat-ready" depending on results of passing the course. According to requirements adopted in NATO, a pilot (crew) is considered "fully combat ready" who has performed exercises for the record and has been trained for combat actions under adverse weather conditions day and night.

Combat training of Air Force units and subunits is organized with the objective of maintaining and further improving their level of combat readiness. It is conducted in the course of day-to-day combat training and during various exercises and maneuvers within the framework of the Norwegian Armed Forces as well as NATO's joint armed forces. During these exercises and maneuvers crews train to execute combat missions inherent to each air arm. In addition, the Norwegian Air Force command makes it a practice to hold special exercises and training sessions, particularly to practice personnel actions under special conditions.

Concerning the latter the foreign press emphasizes that the Norwegian Air Force regularly arranges exercises to check flight personnel's preparedness for survival in case the aircraft is lost over enemy territory and exercises in pilot actions on being captured as well as fighting sabotage groups. A counterterrorist group from the city of Oslo's police headquarters and personnel of the intelligence and counterintelligence school of the Norwegian defense ministry usually act the part of the enemy.

Such exercises are held most often on very rugged mountainous woodland under near-combat conditions. Flight personnel playing the role of crash victims receive field rations for a day, flight maps, compasses and other prescribed personal gear and are dropped in a designated area. The crews' actions under these conditions are checked during exercises, especially with regard to psychological training.

In addition, there are exercises to mop up the aftermath of a catastrophe during an aircraft landing. Aircraft of other country air forces including the United States and Great Britain also take part. One such exercise began with a simulated collision between a transport aircraft and fighter. Then personnel of the air base, the police, and the medical service began performing rescue operations, clearing the runway and mopping up other consequences of the catastrophe.

Prospects for Air Force development. Judging from foreign press reports, the command authority of the Norwegian Armed Forces intends above all to improve the

national air defense system, which in the opinion of NATO military experts presently does not provide reliable cover for unloading points (seaports and airfields) as well as deployment areas of reinforcing units and subunits which are to arrive here from the United States, Great Britain and Canada in case of an "emergency" situation. In connection with this Norway's military leadership presently is taking active steps aimed at developing the air defense system, with the principal measures to be accomplished by 1990. They include adoption of the Improved Hawk system, modernized in accordance with requirements of the Norwegian Air Force command. In addition, under plans for developing the infrastructure and reinforcing the NATO NADGE Joint Air Defense System positions are being constructed for silo-type HADR three-dimensional radars in Northern and Southern Norway. These radars will operate completely in an automatic mode and are capable of detecting airborne targets at a great range (over 400 km). It is also planned to improve the L-70 40-mm antiaircraft guns in the inventory. AAA batteries are to be equipped with new radar sights and supplied with more up-to-date ammunition.

In addition there is considerable emphasis on improving the tactical capabilities of attack aviation. In particular, as noted earlier, it is planned to acquire another 24 F-16 tactical fighters and re-equip the 338th Fighter-Bomber Squadron with them. Work is also under way to modernize the F-16 and F-5 tactical fighters. It is planned to replace their on-board radars, warning receivers, and navigation and communications equipment with more up-to-date gear. New Penguin-3 air-to-ship guided missiles (Fig. 2 [figure not reproduced]) with a range of fire up to 50 km will be included in the armament of F-16 aircraft. In the near future it is planned to purchase new Super Puma transport helicopters to replace the obsolete UH-1B helicopters.

The foreign press notes that when the above measures are implemented the Norwegian Air Force will have the necessary active air defense means for covering the principal air bases and ports intended for receiving allied troops, and the transport resources for moving troops to deployment areas.

6904

Prospects for Development of American EW Equipment for Individual Aircraft Protection

18010065f Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 36-41

[Article by Col D. Figurovskiy, candidate of technical sciences]

[Text] Further improvement in electronic warfare [EW] equipment for individual protection of combat aircraft is considered to be of no small importance among long-range Pentagon measures for expanding tactical aviation's capabilities to deliver effective strikes to the full depth of a TVD [theater of military operations]. Judging from foreign press reports, within the scope of these measures it is planned to re-equip the aviation of the United States and other NATO bloc member countries up to the mid-1990's with EW gear capable of reconnoitering future electronics of an opposing side's air defense with sufficient completeness and promptness and of neutralizing them by jamming with a high degree of reliability. This will contribute to attainment of air supremacy to a considerable extent. It is emphasized in particular that even now the range of possible combat missions of tactical aviation to be performed with the help of EW equipment has become broader than in the 1970's in connection with the appearance of such equipment as AWACS aircraft and airborne command posts. In addition it is believed that in the near future fundamentally new problems will arise, connected in part with the need to counter the electronics of reconnaissance, control, and target designation aircraft of reconnaissance-attack systems.

It is also assumed that there will be a sharp increase in complexity of EW missions against radars for early warning of airborne targets, ground controlled intercept, target designation, and AAA and SAM system fire control as well as against air-to-air and air-to-ground airborne guided missile control radars as a result of the use of achievements of S&T progress, phased antenna arrays, and adaptive antijam devices in traditional air defense electronics. In the opinion of foreign military specialists, an improvement in electronics should cause an abrupt change in the electronic situation on the whole. Table 1 gives the quantitative and qualitative characteristics of these changes for the period of the 1970's, 1980's and 1990's.

Table 1. Characteristics of Electronic Situation for Airborne EW Equipment

Characteristics	Years 1970's	1980's	1990's
Frequency band of air defense electronics	Individual subbands in frequency range 2-12 GHz	Individual subbands in frequency range up 2-40 GHz	Individual subbands in frequency range 2-150 GHz
Average number of pulse signals arriving at warning receiver with aircraft flying at altitude of 12,000 m	40,000	1-2 million	Up 10 million
Nature of pulse repetition period	Stable	Stable, and with regular change and jitter	Stable and with random retuning
Nature of carrier frequency	Stable	With rapid retuning by random law	With rapid retuning but with broader spectrum
Areas of digital technology use	Between-pulse processing	Between-pulse processing, and with phase control within pulse limits, control of modulation coding, radiated power, pulse compression, and operation in bistatic mode	Same as 1980's
Features of missile homing heads	Single-mode, operating in radio or IR band	Two-mode	Multimode, including laser

The western press notes that such increased complexity of the electronic situation will not lead to substantial changes in combat employment tactics of EW equipment. Accordingly no special changes are expected in the mission of basic kinds of aviation EW equipment. Up to the end of the present century it will continue to be subdivided into two large groups: actuating electronic intelligence equipment and electronic countermeasures [ECM] equipment.

Meanwhile the need for accomplishing new missions should cause a sharp growth in tactical capabilities of the equipment in both groups without fail; this can be achieved only by a qualitative improvement in this technology. The U.S. Air Force command proposes to carry out such an improvement in two stages: in the first (1986-1990) it plans to outfit tactical aircraft in the inventory with the ASPJ (Airborne Self-Protection Jammer) combined EW system and in the second (up to 1995) to complete development of the INEWS (Integrated Electronic Warfare System), which will be installed in future tactical aircraft. These new EW capabilities should automatically evaluate the electronic situation and determine the sequence for jamming enemy equipment, select the most effective kinds of jamming and check their effectiveness. Such automation will be based on integration of on-board electronic equipment previously operating separately by the extensive use of electronic computers for their control.

American experts believe that as a result of these measures a transition will be made from the large diversity of types of specialized EW sets in pods to versatile built-in systems. Their versatility with respect both to types of aircraft to be outfitted and capabilities of performing combat missions will be achieved by a simple change in program of the processor controlling the operation of EW equipment.

The ASPJ combined EW system consists of the AN/ALQ-165 electronic jammer and the AN/ALR-67 or AN/ALR-69 warning receivers connected to it (an external view of devices included in the system is shown in Fig. 1 [figure not reproduced]).

The AN/ALQ-165 electronic jammer has a peak pulse power of up to 2 kw and it operates in four frequency bands covering several octaves. The set weighs around 110 kg and it is over 2.5 m long in the pod version. To evaluate the improvement in this design the foreign press cites characteristics of the French Cayman EW set in the Mirage-F.1, Mirage-2000 and Jaguar tactical fighters (see color insert [color insert not reproduced]). The pod length of this set is 5.9 m and it weighs 550 kg. Its two transmitters together are capable of radiating up to 500 watts in a band up to 10 GHz, and up to 1 kw in a band up to 40 GHz.

Judging from western press reports the AN/ALR-69 warning receiver operates in the frequency band of 2-40 GHz and has a sensitivity of 35 db with a 12 db signal-to-noise ratio. Its direction-finding accuracy (mean-square error) in the horizontal plane is 5 degrees and its dynamic range is at least 40 db. Receiver saturation occurs with a signal frequency above 100 kHz. Power consumption is 250 watts and it weighs around 30 kg.

Much attention in designing the system was given to improving its reliability, achieved in particular with the help of a built-in serviceability monitoring system providing automatic detection of up to 96 percent of possible faults, with the mean time of fixing them being 22

minutes. All signal parameters are measured (bearing, carrier frequency, pulse repetition frequency, pulse width, type and scan rate of target equipment antenna, amplitude of received signal) in no more than 0.1 second. Data collected are reflected on an indicator—a cathode ray tube (diagonal screen size 7.5 cm), on an alphanumeric indicator board, and with the help of aural signals in the pilot headset.

In designing the set considerable difficulties were overcome in ensuring electromagnetic compatibility of the transmitting and receiving parts of the ASPJ system. It has been reported in particular that both static methods of channel separation (by signal polarization and antenna radiation patterns) as well as dynamic methods (by emission and reception time, signal amplitude and spectrum) had to be integrated to solve this problem. Because the second group of parameters is used for control in accordance with the existing electronic situation, not only was the problem of electromagnetic compatibility solved to a considerable extent, but the system's combat effectiveness also was improved. For example, switching the receiver antenna to a wider radiation pattern in the time period between ECM set emissions permits more optimal use of signal processor resources and more detailed information about the electronic situation. On the other hand, data coming to the receiver from the ECM set improve the effectiveness of reconnaissance.

The following groups of data are passed from the warning receiver to the ECM set in the developed ASPJ system (made up of the AN/ALR-67 and AN/ALQ-165).

—Measured parameters of intercepted signals, used for direct control of jamming signal parameters.

—A priority list of enemy electronics with signal parameters corresponding to previously collected intelligence. These signals are used basically to control ECM set operating modes in time and tuning it to those parameters which cannot be measured directly by the receiver (for example, an intermediate frequency value).

—Control commands for blanking a jammer emission to preclude the possibility of suppressing friendly electronics and to evaluate the effectiveness of jamming on enemy equipment.

System gear provides for automatic and manual interrogation or updating of data which is lacking. Information going in the opposite direction (from the ECM set to the warning receiver) includes jamming pulse width and repetition frequency as well as amplitude modulation characteristics of continuous-wave jamming. Adaptive control of the receiver is accomplished on the basis of these data, particularly for tuning it away from off-band components of the jamming signal. In addition, there is a periodic exchange of data on operating serviceability of all its elements to improve reliability of system operation. A more complete description of groups of data circulating between the warning receiver and ECM set is given in Table 2.

It is planned to make the ASPJ system structurally part of the aircraft airframe with the exception of a variant for the AV-8B deck-based fighter, which will be a suspended pod. For example, in the late 1980's and early 1990's it is planned to outfit the A-6E, EA-6B, F-14, F-16 and F-18 aircraft with it. Characteristics of ASPJ systems installed in them will differ somewhat in antenna design depending on the type of aircraft and missions it accomplishes. It is planned to make a final selection of the type of warning receiver after completing flight tests of prototypes in the F-16 and F-18 fighters.

In the opinion of American military specialists, the ASPJ system can prove to be ineffective under conditions of the electronic situation forecast for the late 1980's and early 1990's. Therefore a decision was made in 1982 to develop the fundamentally new INEWS system, which is to be installed first in B-1B strategic bombers, F-111 fighter-bombers and A-10 attack aircraft and later (in a somewhat abbreviated version) in future tactical fighters. Ten American firms were included in the preliminary design of this system on a competitive basis. It is planned to choose the best two designs in 1986, to create a prototype in 1987 and to begin full-scale development in November 1988. Award of a contract for series production of the system is expected in 1993.

The INEWS system is intended to combat radars operating in pulse and cotinuous-wave modes, including with target track-while-scan and with tracking by Doppler shift of the carrier frequency. Special attention will be given to possibilities of effectively neutralizing look-down acquisition radars and controlling aviation weapons to conduct fire against them. The system's operating frequency range should be expanded to 150 GHz and it is planned to protect its receiving section from saturation by pulse signals from equipment with a repetition frequency up to 200 kilobits/sec located close to the aircraft.

In developing the system it is planned to use the latest achievements of electronics, including super-fast integrated circuits with active element 1.25 microns in size (including gallium arsenide), as well as optical-acoustic devices. In the opinion of foreign specialists, the complexity of combat missions to be accomplished by the system will require a very high degree of automation of its work and possibly even the use of individual artificial intelligence components. Therefore it is proposed to create an on-board computer especially for the system with a word length of 16 bits and a speed up to three million operations per second.

The foreign press has widely discussed characteristic features of the system. For example, it is believed that it will have the capability to adapt automatically to

Group of data	Data content	
	From warning receiver to ECM set	From ECM set to warning receiver
Measured parameters of intercepted signals	Report on signals actually intercepted and output of data on request about their parameters as well as on control pulses for checking the gear and training crews	Request for data output on specific types of emitters or kinds of enemy electronics
Priority list	Report with data in accordance with query from ECM set	Request for output of all data in receiver memory beginning with equipment having a certain radiating power
	Report with updated data (formed with any substantial change in parameters of intercepted signals)	Request for partial data update
	Report on intercept of new radio signals or cessation of operation of any enemy equipment	
Blanking commands (transmitted over separate communications line)	Reports on blanking frequencies in accordance with query from ECM set	Request for blanking in accordance with parameters of emitted jamming signals
	Blanking request to evaluate effect of jamming on enemy equipment with determination of blanking duration	Report on beginning of jamming or on a change in jamming frequency, containing data on parameters of emitted signals
Serviceability check of system equipment	Periodic query on serviceability and corresponding responding data. Query and response on operating mode. Query and response on serviceability of communications line.	

changes in the electronic situation by a further expansion in interaction of ECM equipment with the aircraft's reconnaissance gear. It is expected that the INEWS system will be able to ensure effective EW against such future electronics as on-board Doppler radars (with high pulse repetition frequency) of next-generation fighters as well as radars of other types and purposes with a carrier frequency up to 150 GHz.

In developing the INEWS system American specialists propose to achieve simplification in servicing aircraft EW equipment and facilitate an improvement in its gear and software. The task is to improve reliability by at least fivefold compared with existing equipment of this type, make the entire design modular, and use the ADA high-level machine language for programming. Although the foreign press essentially has not reported specific characteristics of this system at the present time, some idea of its receiving section can be drawn from data on the AN/ALR-56 receiver installed in the F-15 fighter inasmuch as it is mentioned as a possible prototype for corresponding equipment of the INEWS system. The AN/ALR-56 operates in the frequency band 0.6-18 GHz. The parameters it measures are the intercepted signal's carrier frequency, pulse repetition frequency, pulse width, and antenna scan period. It takes no more than 32 milliseconds to measure these parameters. The foreign press emphasizes that computer-aided design is being widely used in creating the INEWS and automated lines are being created for future production. Pentagon efforts to improve the capabilities of airborne EW equipment are not limited to the measures described above. Modernization and creation of gear for special EW aircraft continue and fundamentallay new ways are being sought for combating the infrared and optical equipment beginning to be used more and more widely for weapon control. It is reported in particular that work is under way to expand the frequency band of the AN/ALQ-99E ECM set (it is installed in the EF-111A Raven EW aircraft, Fig. 2 [figure not reproduced], and in the opinion of foreign specialists presently represents one of the most advanced EW systems), to modernize EW equipment of the EA-6B aircraft and to outfit tactical fighters with the new HARM antiradar missiles.

On the whole, judging from western press reports, development of new airborne electronics is acquiring a more comprehensive character with the inclusion of different equipment in an integrated system. Such integration means that a set of equipment performing certain specific tasks will be required to an increasingly lesser extent for performing varied functions. In the future an integrated system automatically controlled by computer will accomplish tasks of navigation, recognition, communications, actuating electronic intelligence, threat warning, ECM and weapon control. Use of the latest S&T achievements and the desire to find a place for any of them in a new spiral of the arms race also is being fully manifested in the directions of improvement in American airborne EW equipment.

6904

British HOTOL Aerospace Craft

18010065g Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 44-47

[Article by Col V. Gorenko]

[Text] In the mid-1980's the British firms of British Aerospace and Rolls Royce advanced the concept of creating a new means for inserting payloads into low near-earth orbits—the HOTOL (Horizontal Take-Off and Landing) single-stage unmanned reusable aerospace craft. The name of the craft contains its principal difference from traditional vertically-launched means of placing payloads into space.

According to western press reports the concept of the HOTOL craft became possible because of successful results achieved by Rolls Royce in developing its basic design component—a hybrid power plant combining an air-breathing jet and liquid-propellant rocket engines. When the craft flies in the atmosphere it will use oxygen of the air compressed in a special heat exchanger and then supplied to the combustion chamber. It is also noted that British specialists chose this concept after careful analysis of more than 30 different design variants of existing and future means of insertion by the cost/effectiveness criterion, assuming that the basic share of expenditures would go to developing a more costly hybrid power plant in comparison with the liquid-fuel rocket engine. At the same time it is believed that the specific task of the project—creating an automatic craft intended only for performing operations of delivering satellites weighing 7-11 tons into low near-earth orbits—will permit avoiding the expenses of solving a number of complex and costly technical problems in the course of development and operation (for example, assuring crew safety, building launch and repair/renovation complexes and so on).

Judging from statements by British Aerospace representatives, the project's objective is not the creation of a relatively inexpensive means of inserting satellites into orbit, but reducing the cost of this process by the operating characteristics of an aircraft type of craft. They include in particular the possibility of a take-off from conventional runways, which eliminates the restrictions connected with traditional means of insertion being tied to the location of launch complexes and permits the craft to take off in the immediate vicinity of the place where the payload is manufactured, reducing its transportation and inspection expenses. In case there is no urgent need for satellite launch, it can be installed in the cargo hold of the HOTOL craft right at the plant which manufactures the satellite, after which the craft will fly to the launch site (presumably in Kourou, French Guiana), where it

will be fueled with liquid hydrogen and then will insert the satellite into orbit. The possibility of launching the HOTOL from a mother aircraft also is being considered.

The high intensity of its flights is noted as the principal operating advantage of the craft: the length of between-flight preparation will reach 7 days. There are also reports that this cycle may be only 2 days, although British specialists believe that there will probably be no need for this in the initial stage of HOTOL operation. According to calculations, it will take around 8 hours to passivate the craft's systems and remove the payload on completion of the latest flight; exactly 24 hours are set aside for craft maintenance, replacing individual components and inspections; and the remaining 16 hours for placing the payload in the cargo hold, mounting the HOTOL on an acceleration trolley and fueling it with cryogenic fuel components. In addition to the short launch preparation time, the new craft is characterized by less rigid requirements for conditions of an emergency return and landing as well as greater opportunities for lateral maneuvering in comparison with the American Space Shuttle.

According to one variant, the HOTOL craft design represents a monoplane with rear-mounted delta wing resembling the Concorde passenger aircraft of joint Anglo-French production in shape and size (see figure [figure not reproduced]). The craft is 62 m long, has a wingspan of 19.7 m, wing area of 173 m^2, and central fuselage diameter of 5.7 m. The nose contains control system equipment and the front and central sections are occupied by the longest structural element—a tank with liquid hydrogen. Behind it in the tail section are an upper-mounted cargo hold 7.5 m long and 4.6 m in diameter, a small tank of liquid oxygen and the power plant which includes the main propulsion system (three or four hybrid engines) with an air intake in the lower part, as well as engines of the orbital maneuvering system.

In the first diagrams published in the foreign press, in addition to the load-carrying wing panels the craft was equipped with a V-shaped twin-fin tail unit and forward horizontal control surfaces, and the design of the Concorde wing was taken as the basis for the wing. With the objective of increasing lift the wing later was modified and shifted somewhat closer to the tail section to give the craft greater stability, and an additional vertical stabilizer was installed in the nose section. A number of design modifications were made based on wind tunnel tests of the 2-m model in February 1986 (for flying conditions at low altitudes and speeds). Specialists rejected the V-tail and forward-mounted horizontal control surfaces, dimensions of the vertical nose stabilizer were increased and the stabilizer itself was moved back from the nose section. It is assumed that the HOTOL's flying weight to wing area ratio will be much less than for the orbital stage of the Shuttle spacecraft and skin temperature when entering and flying in dense layers of the atmosphere will be accordingly lower and will be a maximum of 930 degrees Centigrade. Because of this the craft's encircling metal heat shield will not require replacement in contrast to the tile heat shield used on the orbital stage of the Shuttle craft. It is planned to use panels of titanium alloys on the upper surface of the HOTOL and panels of nickel alloys on the lower surface (panel size 0.3x0.9 m) and to use panels of composition materials based on carbon in the nose and on wing edges.

The outer semicircular air intake situated in the craft's lower tail section allows use of the effect of underwing compression. The orbital maneuvering system will include two or three liquid-fuel rocket engines operating, like the main power plant, on liquid hydrogen and oxygen. The attitude control system will include 22 jet nozzles located in the nose and tail sections of the fuselage. It is assumed that the craft's thrust-to-weight ratio on take-off will be 0.78 (not counting thrust of the acceleration trolley engines), and the craft's payload-to-launch weight ratio will be 0.035. According to British Aerospace specialists, the operating life of the main power plant is designed for 60 flights of the craft, and airframe life 120 flights.

The scheme of a typical HOTOL flight is depicted as follows in the pages of the foreign press: horizontal take-off and flight using aerodynamic efficiency until reaching a speed corresponding to Mach 5 and an altitude of 25 km; rocket-propelled mode of orbit insertion with shut-down of main power plant on reaching an altitude of 90 km and orbital velocity; flight along a ballistic trajectory to an altitude of 300 km and further along a circular orbit; de-orbit and gliding flight in the atmosphere with a runway landing.

The craft's take-off will be from a runway with the help of a separable acceleration trolley. The latter's use was dictated by the desire for maximum reduction of the craft's take-off weight inasmuch as it would have to be fitted out with a considerably more heavy-duty undercarriage in comparison with that chosen, which is designed only to support the landing of a HOTOL (with spent fuel) weighing 40 tons, i.e., five times less than take-off weight (200 tons). Fuel components can be jettisoned in case of an emergency prior to landing.

Airfield runways 3,000 m long can be used for take-off. The craft's acceleration will be 0.56 g with an angle of attack of 4 degrees, and the trolley acceleration run will be 2,300 m. The craft should separate from the trolley at a speed of over 500 km/hr, acceleration at the moment of separation will be 1.15 g and the wing lift coefficient will be 0.75. It is reported that straight-line motion of the trolley along the runway will be ensured by a laser guidance system. After the craft separates from the trolley the latter brakes; arresting gear is to be used for a complete stop. Initially it was not planned to outfit the trolley with its own power plant, but there are provisions for this at the present time. In addition it is planned to

install a container of liquid hydrogen on it which would be used in the craft's power plant during acceleration before separation from the trolley.

In the initial phase of flight in the atmosphere HOTOL gains altitude and speed at an angle of 24 degrees, and the power plant operates using oxygen of the air. Two minutes after launch the craft's speed should be Mach 1 and 4.5-5 minutes later Mach 1.7 (altitude of 12 km, 80 km away from the launch site). Nine minutes after take-off (altitude of 25 km, speed of Mach 5) the aerodynamic sector of the insertion trajectory ends, the underfuselage air intake closes and the power plant begins operating in a liquid-fuel rocket engine mode using liquid oxygen from the on-board tank. According to calculations of British specialists, some 34 tons of liquid hydrogen, or 18 percent of the craft's take-off weight, is expended on the aerodynamic leg of the flight. Power plant shut-down occurs on attaining orbital velocity at an altitude of around 90 km. Then the craft will make a free flight along a ballistic trajectory, ascending to an altitude of 300 km, after which there is a so-called rounding of the trajectory for the transition to a flight in a circular orbit by switching on two orbital maneuvering engines.

The nominal duration of the HOTOL's orbital flight, during which automatic operations connected with insertion of satellites in orbit will be carried out, will be less than one hour. A satellite is to be separated by a spring-loaded pusher after cargo hold doors open. Orbital maneuvering engines are turned on for the craft's de-orbiting and landing after the satellite has been inserted. It is to enter the dense layers of the atmosphere (at an altitude on the order of 120 km) with an angle of attack around 80 degrees, which is two times greater than for the Space Shuttle orbital stage. As altitude decreases the craft will begin gliding at hypersonic speed, executing a lateral maneuver for descent and the approach to the landing area. It is believed that because of the great range of the lateral maneuver, which is 4,000-5,000 km, the craft will be able to make a landing in Europe (presumably in Great Britain or France).

In the final stage of gliding flight when approaching the glide path for landing, the craft's descent is at an angle of 16 degrees. Leveling off, which takes approximately 9 seconds, begins 23-25 seconds before touch-down on the runway (at a speed of around 460 km/hr), and it descends at an angle of three degrees in the next 14 seconds. Design speed at the moment of runway touch-down is 315-350 km/hr and the landing run is around 1,800 m.

The first information about the HOTOL project appeared in the western press in 1984 and, as often happens, had the nature of a sensational "leak" of secret information. In particular, there was a report about long-range plans being financed by the government of Great Britain for a reusable horizontal take-off and landing spacecraft to be created by the firms of British Aerospace and Rolls Royce and which was to be used for military purposes. The report was immediately denied by representatives of the British Department of Defence and the firms in question, but just a few months later a project of the craft as a means of inserting satellites into space was presented in concise form at the Farnborough International Air Show.

In mid-1985 British Aerospace proposed to the British ministry for trade and industry that funds be allocated for investigating the feasibility of the HOTOL concept, and in February 1986 initiative work by British Aerospace and Rolls Royce received support of the government and of the British National Space Center established by that time. Recommendations developed by the Center proposed a ten-year program for creating the craft. On completion of work to assess concept feasibility (figured to be before November 1987) it is planned to begin a two-year stage of research for final determination of airframe configuration and then a two-year stage for its initial development. At the same time (after November 1987) it is planned to begin a four-year program to demonstrate the possibility for developing a hybrid power plant and in parallel with it to begin a six-year program for creating its flying model. It is planned to begin the stage of immediate manufacture of the craft's first prototype in 1992. There are to be 19 test flights of HOTOL during 1996-1997, including seven with orbiting. It is planned to place the craft in operational use during 1998-2000. In the estimates of British experts the craft's design operating life is 20 years. The overall weight of payloads planned to be orbited with HOTOL during these years will be 9,000 tons (1,286 and 818 flights with a load-lifting capacity of 7 and 11 tons respectively). It is also assumed that the cost of inserting payloads will be considerably less than for the Space Shuttle: by 50 percent into low near-earth orbits and by 80 percent into stationary orbits (for the Space Shuttle the cost is 3,000 and 30,000 dollars/kg respectively). The total cost of inserting one satellite by HOTOL will be $1.1 million. At the same time, some western specialists believe these estimates to be too optimistic and based on the supposition of the craft's lengthy troublefree operation.

Judging from foreign press reports, expenses for the program of creation and operation of HOTOL craft are set at $6.3 billion, of which the bulk (around $4.9 billion) will go for development and manufacture of the craft.

British Aerospace specialists assume that it is possible to adapt one or more HOTOL craft in the future for transporting passengers over long distances in an automatic unmanned mode or for operations of delivering cosmonauts into and returning them from orbit. It is planned to accommodate them in a lounge (where there can be up to 60 passengers) or self-contained sealed capsules accommodated in the craft's cargo hold. According to estimates, a flight from London to Sidney,

Australia will take around one hour and will pass over approximately a fourth of the globe under weightless conditions along a ballistic trajectory.

Meanwhile it is noted that clear prospects for realizing the HOTOL project still have not been defined at the present time. It is believed that they will depend on the attitude of the European Space Agency toward it. In connection with this the British side is making efforts at various levels including governmental aimed at including this project in the category of programs financed by the European Space Agency. In addition, Great Britain is interested in a positive assessment of the project by France above all; western specialists believe that the HOTOL craft represents an alternative for France to the future French Ariane-5/Hermes space system to a certain extent.

In addition to other reasons, the restrained attitude of the European Space Agency toward the HOTOL project is explained in the foreign press by insufficiency of information about the craft's hybrid power plant, which Great Britain is keeping secret. As one argument in favor of the project, British officials are citing concern over Western Europe's possible loss of competitiveness in the area of future aerospace capabilities with respect to the United States and Japan. At the same time, a number of their statements contain a threat to West European partners of turning for financial support of the project to the United States, which already has begun research connected with creating hypersonic aerospace craft. It has been reported in particular that in early 1986 the HOTOL project was discussed with representatives of the American National Aeronautics and Space Administration, with which some cooperation in the future is not precluded.

In February of that same year the European Space Agency issued two requests for proposals on creating a future hybrid power plant. In the assessment of the foreign press, this indicates some interest in the British project by the European Space Agency. In connection with the fact that up until 1990 the European Space Agency plans only to conduct conceptual studies of future means for inserting payloads into space, however, British specialists fear that the beginning of the HOTOL program's realization thus will be put off for at least three years if alternative sources for its financing are not found.

In the opinion of some western observers, the HOTOL project can be of interest only with a reorientation toward the craft's use for military purposes. This is explained by the fact that in many areas of technology the deciding voice in the West in opening up major research and development programs rests with militaristic circles. The fact that at the Farnborough Air Show along with the craft's civilian purpose British Aerospace was advertising its allegedly great potential as a high-readiness, high-survivability means of urgent delivery of military satellites into orbit also is indicative in this respect. The foreign press also emphasizes that HOTOL will be able to play a certain role in implementing the so-called EuroSDI, which is a kind of supplement to the American star wars program for which the government of Great Britain presently is an ardent adherent. In addition the thought is expressed that the HOTOL project will provide a technical base for creating alternative weapon systems. For example, the craft could be used as a hypersonic intercontinental bomber carrying nuclear weapons.

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FRG Air Force Mobile Aerial Reconnaissance Data Processing Complex

18010065h Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) p 48

[Article by Col L. Konstantinov]

[Text] The West German Air Force has two aerial reconnaissance squadrons for accomplishing aerial reconnaissance missions: the 51st (Bremgarten Air Base) and 52d (Leck). Each of them has two reconnaissance detachments equipped with RF-4E Phantom II aircraft (15 aircraft each).

To expand these squadrons' tactical capabilities the on-board reconnaissance gear and other aircraft equipment is being modernized, their crews' combat training is being improved, and ground equipment meeting modern requirements for speed and accuracy of processing aerial reconnaissance data is being created.

Concerning the latter, the foreign press reports that at the present time each FRG Air Force reconnaissance detachment has a RAMA (RECCE Auswerte-und Meldeausstattung) mobile ground complex for processing and evaluating data received from reconnaissance aircraft crews (see figure [figure not reproduced]). All its equipment is contained in 16 container-type modules (huts) adapted for air and ground transportation. The complex comes with self-contained power and water supply systems. Movie and photographic films and IR imagery can be developed and interpreted using its installed gear. Materials are evaluated and summaries compiled here as well. The technological process is arranged so that the entire processing and evaluation cycle takes a minimum of time.

In addition to the RAMA complexes in the detachments, the squadrons have expanded versions of them with a number of additional modules for processing radar data transmitted from the aircraft.

According to reports of the West German military press, the modules' design is considered successful inasmuch as their assembly and disassembly as well as creation of a complex from them in the most favorable combination for specific conditions are a relatively simple matter and do not take much time.

6904

U.S. Navy Amphibious Warfare Forces

18010065i Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 49-55

[Article by Capt 1st Rank P. Lapkovskiy and Capt 2d Rank V. Dotsenko]

[Text] Having unleashed an unprecedented arms race, U.S. ruling circles give a prominent place to the Navy in their aggressive plans. In an attempt to achieve military supremacy over the Soviet Union, significant efforts are being applied to implement a program announced by the U.S. administration for increasing the regular Navy ship order of battle to 600 ships by 1990. Amphibious warfare forces, which are called upon to support combat activities of the Marines—the shock detachment of American imperialism—will see substantial development both qualitatively and quantitatively. The amphibious warfare forces are intended for moving an assault force by ocean (sea) and landing it on an enemy shore. They include landing ships and vessels of various types as well as assault landing craft. All these forces are brought together in amphibious groups of the Atlantic (one group) and Pacific (two groups) fleet surface forces. The groups consist of squadrons.

Judging from foreign press reports, the following basic directions can be seen in postwar development of U.S. Navy amphibious warfare forces:

—Construction of landing ships with improved characteristics based on the tank landing ships, dock landing ships, attack troop transports and amphibious cargo ships widely used in World War II;

—Introduction of fundamentally new subtypes of ships to the order of battle such as amphibious assault ships and amphibious transport docks;

—Creation of multipurpose landing ships which combine the functions of dock landing ships, amphibious assault ships, amphibious transport docks, cargo transports and command ships;

—Development of assault landing craft (including air cushion vehicles) with larger capacity, higher speed and improved seaworthiness.

According to data of "Jane's" reference on ship order of battle, the regular U.S. Navy (not counting ships of the reserve) presently numbers 61 landing ships and transports. They include 2 command ships ("Blue Ridge" Class), 5 multipurpose ships ("Tarawa" Class), 7 amphibious assault ships ("Iwo Jima" Class), 13 amphibious transport docks (11 "Austin" Class and 2 "Raleigh" Class), 11 dock landing ships (3 "Whidbey Island" Class, 5 "Anchorage" Class and 3 "Thomaston" Class), 18 "Newport" Class tank landing ships and 5 "Charleston" Class cargo ships. In addition, two amphibious transport docks ("La Salle" and "Coronado") were refitted as command ships and seven ships are in the Naval Reserve, of which two "Newport" Class tank landing ships (part of the emergency reserve) are actively used for training amphibious assault forces. The principal tactical-technical characteristics of landing ships and transports are given in Table 1.

The *command ships* LCC 19 "Blue Ridge" and LCC 20 "Mt. Whitney" (Fig. 1 [figure not reproduced]) of the U.S. amphibious forces, built in the early 1970's, are the flagships of amphibious forces of the Pacific and Atlantic fleets respectively. They are intended for command and control of sea, air and ground forces in all phases of an amphibious landing operation or in combat actions to land tactical assault forces. In addition, each of them can take aboard and put ashore a limited number of Marines, for which these ships have aboard three assault transport helicopters and up to four landing craft. The ship's internal spaces permit accommodating some 700 personnel of the amphibious assault force staff, other staffs and control organs. These ships are equipped with the latest communications equipment and automated control systems.

The most up-to-date ships of the U.S. amphibious forces are the *multipurpose amphibious assault ships* (LHA) of the "Tarawa" Class. The idea of creating them appeared in the period of U.S. aggression in Vietnam. According to the estimate of American military specialists, the actions of tactical amphibious groups which included a helicopter carrier, amphibious transport docks and dock landing ships with Marine subunits aboard proved especially effective in landing amphibious forces. The foreign press noted, however, that even in the absence of serious enemy opposition the organization of the amphibious force's landing was disrupted due to lack of coordination in ship actions. Therefore the decision was made to create an amphibious assault ship which would possess the qualities of landing ships of several subtypes (helicopter carrier, amphibious transport dock, dock landing ship and cargo transport) as well as a command ship. The amphibious assault ship was to become the nucleus of an amphibious assault group capable of independently accomplishing tactical missions in amphibious assault landings.

The presence aboard the amphibious assault ship of assault transport helicopters and landing craft permits landing an amphibious force and unloading combat

Ship Class--Nr in Commission (Side Numbers), Year Commissioned	Displacement, tons: Standard / Full	Principal Dimensions, m: Length / Beam / Draft	Power Plant Output, hp / Maximum Speed, knots	Endurance nm / At Speed, knots	Crew	Armament[1] (Troop Capacity)
Command Ships of Amphibious Forces						
BLUE RIDGE--2 (LCC 19, 20), 1970-1971	17 100 / 19 290	188.5 / 33 / 8.2	22 000 / 23	13 000 / 16	814	2x8 Sea Sparrow SAM, 2x2 76-mm automatic guns, (3 helicopters, 4 landing craft)
All-Purpose Landing Ships						
TARAWA--5 (LHA 1-5), 1976-1980	. / 39 300	250 / 32.3 / 7.9	70 000 / 24	10 000 / 20	935	2x8 Sea Sparrow SAM, 3x1 127-mm auto guns, 6x1 20-mm auto guns, (30 helicopters, 6 landing craft, 1703 Marines)
Amphibious Assault Ships						
IWO JIMA--7 (LPH 2, 3, 7, 9-12), 1961-1970	17 000 / 18 300	183.7 / 25.6 / 7.9	22 000 / 23	19 000 / 15	754	2x8 Sea Sparrow SAM, 2x2 76-mm auto guns, (26 helicopters, 1746 Marines)
Amphibious Transport Docks						
AUSTIN--11 (LPD 4-10, 12-15), 1965-1971	10 000 / 17 000	173.3 / 30.5 / 7	24 000 / 21	11 000 / 16	425	1x2 auto guns (6 helicopters, 8 landing craft, 930 Marines)
RALEIGH--2 (LPD 1, 2), 1962,1963	8040 / 13 900	158.4 / 30.5 / 6.7	24 000 / 21	16 000 / 10	429	3x2 76-mm auto guns (6 helicopters, 8 landing craft, 930 Marines)
Dock Landing Ships						
WHIDBEY ISLAND--3 (LSD 41-43), 1985-1987	11 125 / 15 726	185.6 / 25.6 / 6.3	41 600 / 20	.	356	2x6 Vulcan-Phalanx AA (21 landing craft or 4 LCAC, 450 Marines)
ANCHORAGE--5 (LSD 36-40), 1969-1972	8600 / 13 700	168.6 / 25.6 / 6	24 000 / 20	10 000 / 16	374	3x2 76-mm auto guns, 2x6 Vulcan-Phalanx AA (6 landing craft, 376 Marines)
THOMASTON--8[2] (LSD 28-35), 1954-1957	6880 / 12 150	155.4 / 25.6 / 5.8	24 000 / 22	10 000 / 16	400	3x2 76-mm auto guns (21 landing craft, 340 Marines)
Tank Landing Ships						
NEWPORT--20[3] (LST 1179-1198) 1969-1972	. / 8450	158.7 / 21 / 5.3	16 000 / 20	9500 / 15	290	2x2 76-mm auto guns (29 tanks or amphibian tractors, 400 Marines)
Amphibious Cargo Ships						
CHARLESTON--5 (LKA 113-117), 1968-1970	10 000 / 18 600	175.4 / 18.9 / 7.7	19 250 / 20	10 500 / 16	356	3x2 76-mm auto guns (9 landing craft, 226 Marines)

1. The number of missile and gun mountings and the number of rails and barrels in them are denoted on either side of an "x" sign.
2. LSD 28-31 and LSD 35 are in reserve.
3. LST 1190 and 1191 are in the Naval Reserve Force.

equipment and logistics items not only directly on shore but also in the depth of enemy territory. It is possible to base a composite air group aboard these ships which includes some 30 helicopters of various types including heavy (CH-53E Super Stallion, CH-53D Sea Stallion, see color insert [color insert not reproduced]) and medium (CH-46 Sea Knight) assault transport helicopters and fire support helicopters (AH-1J and AH-1T Sea Cobra), and V/STOL aircraft. Up to nine CH-53E (CH-53D) or 12 CH-46 helicopters can operate simultaneously from the flight deck of "Tarawa" Class amphibious assault ships, and the hangar deck accommodates 19 heavy or 26 medium assault transport helicopters. One typical variant of the make-up of an air group can be as follows: 8 CH-53, 16-18 CH-46, and 4 AH-1 and UH-1 Iroquois helcopters.

The amphibious assault ship has four LCU 1610 or LCU 1466 tank landing craft or six LCM 6 landing craft for carrying personnel and combat equipment.

"Tarawa" Class ships can take aboard an overall total of some 200 pieces of armored equipment including 40 LVTP-7 amphibian tractors. All the landing craft permit delivering up to 1,500 persons ashore simultaneously. The foreign press notes that five "Tarawa" Class ships are capable of accomplishing the very same missions as eight dock landing ships, four amphibious cargo ships and two amphibious assault ships simultaneously.

To facilitate command and control of forces and resources when landing amphibious forces, the amphibious assault ships are equipped with the ITAWDS (Integrated Tactical Amphibious Warfare Data System). It reflects the surface and air situation in the landing area in real time, calculates optimum options for employing weapons and EW capabilities of an amphibious assault force, aviation, and ship support forces.

"Iwo Jima" Class *amphibious assault ships* (LPH) (Fig. 2 [figure not reproduced]) are special construction ships. Each of them is designed for moving a reinforced Marine battalion with authorized weapons and combat equipment and landing it in the tactical depth of the enemy defense with the help of assault transport helicopters. The ship can support the simultaneous take-off of seven CH-46 Sea Knight helicopters or four CH-53 Sea Stallion helicopters (the hangar accommodates 20 or 11 such helicopters respectively). A group of helicopters taking off simultaneously from one ship can deliver some 300 persons to an assault landing area in one trip. Assault landing ships in the U.S. Navy amphibious forces permit carrying some 12,000 landing personnel with light weapons simultaneously. Foreign military specialists consider the basic drawback of such ships to be the absence of a docking well for landing craft and the impossibility of their carrying heavy combat equipment; therefore they cannot conduct independent landings.

Eleven "Austin" Class and two "Raleigh" Class *amphibious transport docks* (LPD) represent a combination of an amphibious assault ship, a dock landing ship and a cargo transport. They can independently land and supply a force on an unprepared enemy coast. Each such ship is capable of landing some 1,000 personnel by the combination method and unloading up to 3,000 tons of cargo.

"Thomaston" Class (three in commission and five in reserve) and "Anchorage" Class (see color insert [color insert not reproduced]) *dock landing ships* (LSD) are for delivering assault landing craft to the landing area for unloading attack troop transports and amphibious cargo ships. Each dock landing ship takes aboard over 300 Marines. According to foreign press reports, obsolete "Thomaston" Class dock landing ships will be replaced by LSD 41 "Whidbey Island" Class ships under construction.

The basic purpose of "Newport" Class *tank landing ships* (two in the naval reserve force) is to transport an assault force with heavy nonamphibious equipment and land it on an unprepared beach without the use of assault landing craft. Their distinguishing feature is the presence of a bow ramp and stern ramp. The bow ramp (36.3 m long) is extended on support rollers by a system of electromechanical winches and special tackle. Such an arrangement provides for unloading combat equipment weighing up to 75 tons directly from the upper deck ashore. The cumulative weight of transported equipment is almost 5,000 tons. More than 20 tanks, amphibious APC's or vehicles can be accommodated on the ship's upper and tank decks. In addition, each tank landing ship takes aboard some 430 Marines.

"Charleston" Class *amphibious cargo ships* (LKA) are intended for delivering troops and combat equipment to the landing area, where they are placed ashore with the help of assault landing craft or unloaded directly at a berth. A distinguishing feature of these ships is the presence of heavy-duty load-hoisting arrangements which allow unloading to both sides simultaneously.

With the commissioning in 1980 of the fifth "Tarawa" Class amphibious assault ship the United States completed a 25-year program of organizational development of amphibious forces. During this period the speed of all landing ships increased to 20-24 knots and their displacement rose by more than 1.5 times. According to calculations of foreign military specialists, at the present time the U.S. Navy's amphibious forces are capable of moving 1.15 Marine expeditionary divisions (around 65,000 persons with corresponding weapons and combat equipment) across the ocean and landing them on an unprepared beach. The American military command believes that by the mid-1990's their amphibious forces will permit simultaneously transporting a Marine expeditionary division and an expeditionary brigade with implementation of programs for building "Wasp" Class amphibious assault ships and "Whidbey Island" Class dock landing ships. Counting the 15-percent reserve of

ships, the U.S. Navy command determined once and for all the necessary troop capacity of the amphibious fleet as 1.5 expeditionary divisions, which will require increasing the overall load-lift capacity of ships by more than 50 percent.

The heightened demands for increasing troop capacity and rejuvenating the ship order of battle (according to standards existing in the U.S. Navy, the average time ships are commissioned should not exceed 25-30 years) led to development of a long-range program for development of amphibious forces. In accordance with the program it is planned to build "Whidbey Island" Class dock landing ships, "Wasp" Class amphibious assault ships as well as LCAC type air cushion landing craft. The following was provided for in designing the new ships: their further universalization; the possibility of their accommodating air cushion landing craft, heavy assault transport helicopters and V/STOL aircraft; and an increase in survivability, combat stability, troop capacity, speed and endurance. Modern electronic systems and antiaircraft, missile and gun weaponry will be included in the equipment of new landing ships.

"Whidbey Island" Class ships are a further development of "Anchorage" Class ships. Two helicopter pads have been set up on their decks allowing helicopters of all types including CH-53E Super Stallion heavy assault transport helicopters and V/STOL aircraft (Harrier AV-8A and AV-8B) to be received.

At the present time three such ships have been handed over to the Navy and six are in various stages of construction. After their commissioning it is planned to begin building a modernized version of dock landing ships of this design (six ships: LSD 49-54). Judging from foreign press reports, this variant will be capable of delivering a considerably greater volume of cargoes to an assault force landing area because of a reduction in the number of transported LCAC (from four to two). It is planned to have 14 "Whidbey Island" Class dock landing ships by 1994 in accordance with the shipbuilding program adopted.

"Wasp" Class amphibious assault ships (a series of 11) are a further development of the amphibious assault ships. The lead ship was laid down in May 1985. Her full displacement is around 40,500 tons, she is 257.3 m long, has a beam of 32.3 m, a draft of 8 m, main power plant output is 70,000 hp, maximum speed is 24 knots, and she has an endurance of 10,000 nm at a speed of 20 knots. It is planned to install two eight-cell Sea Sparrow surface to air missile system launchers and three Vulcan-Phalanx 20-mm AAA [sic] systems. The crew will number 1,080 and will receive an additional 1,873 Marines as an expeditionary battalion. If necessary a 600-bed hospital with six operating rooms can be set up on the ship.

The foreign press reports that useful volume of spaces intended for receiving landing personnel and accommodating combat equipment and logistics items will be the very same as for the "Tarawa" Class amphibious assault ships. Meanwhile the ships' tactical capabilities will be improved because they accommodate three LCAC type air cushion craft (up to 18 LCM-6) and a larger number of helicopters and aircraft. Depending on missions to be accomplished, composition of the air group may vary (6-8 AV-8A and AV-8B Harrier aircraft and up to 30 helicopters of various types, or 42 helicopters, or 20 aircraft and 4-6 helicopters). It is expected that the LHD 1 "Wasp" will be handed over to the Navy in 1989 and construction of five amphibious assault ships of this design is expected to be completed by 1994, after which a gradual removal of "Iwo Jima" Class amphibious assault ships from the order of battle will begin.

The U.S. Navy command plans to modernize "Austin" Class amphibious transport docks, after which they will be able to remain in the fleet order of battle up to the end of the 1990's. Funds for modernizing the first seven ships have been allocated beginning in fiscal year 1987.

It is planned to begin constructing LST-X Class ships in the late 1990's as replacement for "Newport" Class tank landing ships. According to the preliminary design, their displacement will be 9,000 tons, the length 160 m, beam 22 m, draft 5 m, maximum speed 20 knots, and endurance 6,000 nm. The output of the diesel power plant will reach 16,000 hp. Armament is two Vulcan-Phalanx 20-mm AAA systems. There will be a crew of 300. The ship will take aboard 400-500 landing personnel, around 30 tanks and 2-4 landing craft.

In the opinion of foreign military specialists, the experience of landing amphibious assault forces in local wars and during exercises has shown that amphibious assault landing craft available at the present time (Table 2) do not satisfy modern requirements. Their low speed (9-12 knots) and insufficient seaworthiness (no more than 3 on the scale) can negatively affect the course of an amphibious landing operation. Those deficiencies force having inner stations and maneuver areas for landing ships when landing at a distance of 2-5 nm from shore, i.e., in the zone of sufficiently effective fire from shore. With consideration of these circumstances the United States developed LCAC type air cushion landing craft (full weight 149.5 tons, maximum load-lift capacity 70 tons, speed up to 50 knots, endurance of 300 nm at a speed of 35 knots). The craft can negotiate obstacles up to 1.3 m high with a slope of 11-13 degrees. With sufficient numbers of them operational it will be possible to move the landing ship stations and maneuver areas 30 nm or more from shore. The foreign press emphasizes that this will permit achieving tactical surprise and reducing the vulnerability of landing ships and assault landing craft to enemy weapons and mine ordnance of the antilanding defense.

Construction of LCAC type air cushion landing craft (Fig. 3 [figure not reproduced]) began in February 1983 by Bell Aerospace Textron in New Orleans. Their number in the series has not yet been finally determined;

Class of Landing Craft	Displacement tons: Standard / Full	Principal Dimensions, m: Length / Beam / Draft	Endurance, nm / Speed, knots	Troop Capacity
LCU1610	200 / 375	41.1 / 8.8 / 1.9	1200 / 8	3 tanks or 170 tons of cargo
LCU1466	180 / 360	36.3 / 10.4 / 1.8	. / 10	3 tanks or 180 tons of cargo
LCM8	55 / 115	22.5 / 6.4 / 1.6	150 / 9	One tank or 60 tons of cargo
LCM6	22 / 60	17.1 / 4.3 / 1.2	. / 9	80 Marines or 35 tons of cargo
LCVP	8 / 13.5	10.9 / 3.2 / 1.1	110 / 9	36 Marines, or one 105-mm howitzer, or 3.2 tons of cargo

according to the data of various foreign sources it will be from 90 to 130. The five-year shipbuilding program (fiscal years 1986-1990) provides for allocation of funds for building 60 craft (an average of 12 per year). Military specialists note that by this time ships of the U.S. Navy amphibious forces will be capable of receiving that number of these craft in docking wells.

Ship-based assault transport helicopters (Table 3) are widely used for landing an amphibious assault force. Their primary purpose is to land an assault force in the depth of the enemy defense, transport weapons and combat equipment, evacuate the wounded and evacuate damaged equipment, including aircraft and helicopters. The CH-53E Super Stallion heavy assault transport helicopters are considered the most up-to-date.

Table 3. Tactical-Technical Characteristics of U.S. Marine Assault Transport Helicopters

Characteristics	CH-53E Super Stallion	CH-53D Sea Stallion	CH-46D Sea Knight
Maximum take-off weight, kg	33,300	19,000	10,400
Cruising speed, km/hr	280	270	260
Service ceiling, m	5,600	6,400	4,200
Maximum range, km	.	410	380
Load-lift capacity: Marines with full gear, persons	55	37	26
Crew	3	3	3

To improve tactical capabilities of assault landing craft the United States is continuing work to create the MV-22A Osprey VTOL aircraft, which combines the qualities of aircraft and helicopter. As expected, it will replace CH-46 Sea Knight helicopters in the Marines. The aircraft will have a cruising speed of 465 km/hr (a maximum speed of 555 km/hr), a ceiling of 12,000 m, a take-off weight of 18 tons, a load-lift capacity of 4.5 tons and a range of 3,700 km.

The modern status and development prospects of the U.S. Navy amphibious forces, a primary mission of which is to ensure strategic mobility of Marine forces, once again indicate an intensified aggressiveness of the Washington administration's foreign policy course.

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Diesel Submarines

18010065j Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 56-62

[Conclusion of article by Capt 1st Rank V. Kipov]

[Text] Part one* of the article reported on programs for building future diesel submarines for navies of a number of countries. Information is given below on design features of these submarines.

The western press notes that in the next few years the list of countries with submarines may grow. Malaysia, Singapore, the United Arab Emirates, Saudi Arabia and South Korea are mentioned as possible candidates. Therefore in addition to filling orders, firms holding a leading place in submarine construction are developing more and more new submarine projects incorporating the latest S&T achievements.

Special attention in developing future submarines is given to existing and prospective achievements in creating means of detection. Antisubmarine ships extensively use passive sonar with very long (1,000 m or more) towed linear antennas. The automated signal processing of such a low-frequency narrow-band set permits collecting data on direction and range to a target and classifying it according to the noise spectrum. Therefore a reduction in submarine noise level is considered problem number one. The use of active sonars and sonobuoys requires a reduction in the reflecting capacity of submarines by using antisonar coatings.

Steps are being taken to reduce the reflecting capacity and IR emission of a submarine hull and masts as well as to reduce the time for using snorkelling devices, periscopes and extensible antennas in order to minimize the likelihood of submarine detection by radars and IR receivers. Successes in creating modern magnetic detectors are considered in designing submarines. While the detectors previously were used only on ASW aircraft, it is expected that in the very near future helicopters will be equipped with them and subsequently such detectors will be deployed at sea on special buoys. To counter this capability it is planned to use advanced degaussing systems and make wide use of nonmagnetic materials in future submarines. An increase in submarine submergence depth will serve these same purposes. Foreign specialists estimate that the likelihood of detecting a submarine running at a depth of 300 m with a speed of 20 knots is two times less than for a submarine with a speed of 10 knots at a depth of 100 m. It is planned to increase operating depth and maximum diving depth by strengthening the submarine hull, using lightweight materials in structural components not subjected to the effect of water pressure, and using new titanium alloys and other new materials that are stronger than HY-80 quality steel and its equivalents.

Measures to reduce noise level include choice of an optimum hydrodynamic hull shape providing laminar flow and precluding the appearance of vibration and cavitation on protruding parts and near the screw. Heightened demands will be placed on vibration-proofing and sound-insulating foundations and coatings as well as on individual noise sources, particularly the engines, compressors, pumps and transformers.

It is assumed that all these measures will contribute to better concealment of submarine actions and simultaneously will provide favorable conditions for operation of their highly sensitive sonar equipment. Inasmuch as the use of absorbing antisonar coatings reduces a submarine's reflecting capacity only to certain limits, her dimensions must be as small as possible. This demand extends both to the submarine as a whole and to the mast fairwater and rudders.

The disposition and volume of the main ballast tanks determine a submarine's draft and condition on the surface as well as reserve buoyancy, which usually is a little more than 10 percent of surface displacement. The pressure hull accounts for approximately half of the weight of hull structures. A submarine must have a teardrop shape with an optimum length-diameter ratio (within the range of 6-8) to provide for minimum resistance, good propulsive qualities and high maneuverability in a submerged condition.

Horizontal stabilizers and vertical rudders located in the stern create dynamic stability in a submerged condition. An alternative variant of stern control surfaces is an X-shaped arrangement in which each rudder plane controls both in the vertical and horizontal planes. It is believed that this rudder configuration improves maneuverability and in particular reduces the turning circle diameter, but complicates the design and requires use of a computer.

An increase in submergence depth expands the submarine's capabilities for maneuvering in the vertical plane throughout the range of speeds and also provides a number of other advantages: it allows operating beneath the thermocline, which reflects and refracts acoustic waves; using deep sound channels along which signals can propagate over great distances; and increasing the submarine's degree of protection and survivabilitiy.

The safety factor, equal to the ratio of design depth to operating depth, is 1.5-2.0 for the majority of modern submarines. With certain hull shapes hull sections can withstand (without failures) stresses exceeding the yield limit of metal by 15-20 percent, which is achieved by using external or internal circular frames.

By using achievements in the field of computer technology, developers of future submarines are attempting to integrate submarine weapons and all electronics and technical equipment necessary for performing assigned missions into a tactical system. Such integration, which

is taken to mean the unification of individual subsystems for their effective functioning as a single whole, is caused by an increase in the volume of data coming from modern situation coverage facilities, as well as the increasing complexity of weapons. Tactical data control systems [NTDS—naval tactical data system] or automated tactical control systems and sonar systems are the central element of this system.

In the interests of employing submarine weapons the NTDS determines the motion of several targets, produces data for firing against them, controls preparation of weapons for launch (or firing) and its execution, and then controls the guidance of wire-controlled torpedoes. In addition to these functions, which are inherent to existing fire control systems, the NTDS collects, processes and displays data on the existing situation, including an estimate of hydrologic conditions; documents actions during an attack for subsequent analysis; and supports the system's combat readiness using built-in monitoring gear. It is presumed that the automated control system will additionally provide control over the submarine's technical equipment including the power plant and propulsion control stations. Foreign press materials indicate that an improvement in automated control systems envisages an improvement in their structure, software and man-machine interaction.

NTDS's created by American, British, Dutch, Italian and Norwegian firms are being installed in submarines under construction and in future submarines. The American firm of Singer developed the SCCS Mk 2 NTDS (Fig. 1 [figure not reproduced]) for export based on M68000 microprocessors. It includes up to eight standardized control consoles, a commander's display, and a device for converting and processing data coming both from one's own as well as from external data sources. Two data buses with a band up to 5 MHz are used for integrating all these devices. The NTDS determines the motion of 25 targets, prepares firing data on four targets, and supports the firing of wire-controlled torpedoes as well as antiship missiles.

Data is displayed in graphic and alphanumeric form on a color display (48.5 cm diagonal measurement) and on a plasma panel. There is a light pen, sensor device, marker control device and alphanumeric keyboard (Fig. 2 [figure not reproduced]) on the console for the operator's work.

The West German firm of Thyssen Nordseewerke is building a Type TR 1700 submarine for the Argentine Navy and an "Ula" Class submarine (Type 210/P6071) for the Norwegian Navy. Type TR 1700 submarines are equipped with the Dutch SINBADS NTDS, which provides for simultaneous firing against three targets. They are armed with six torpedo tubes and have a standard displacement of 1,800 tons, a length of 66 m, and submerged speed of more than 24 knots. The first two submarines were built and handed over to the client in 1984 and 1985. They made a transatlantic passage (more than 6,000 nm) at an average speed of 10-11 knots. Another four submarines of the same class are being built at a yard in Buenos Aires. "Ula" Class submarines (standard displacement of 940 tons) will be equipped with the DBQS-21 sonar system of the firm of Krupp Atlas-Elektronik and the Norwegian MSI-90U NTDS made with KS-900 computers with distributed data processing (it includes standard KS-9000 control consoles). It is presumed that in addition to the "Ula" Class submarine this NTDS will be used on the Type 211 submarine being developed for the West German Navy.

The British firm of Ferranti created the KAFS NTDS, which includes the FM1600E type computer and three Argus M700/20 microprocessors. It permits displaying up to 35 targets and guiding torpedoes against four targets. This NTDS is installed in "Upholder" Class submarines (Type 2400) and in the export version aboard submarines of navies of Australia, Brazil and other countries.

The West German firm of Krupp Atlas-Elektronik is producing the PSU-1 and PSU-2 sonars, which detect, classify, determine bearings to a target and accomplish underwater communications. The cylindrical antenna forms 32 beams of the radiation pattern. The situation is displayed on a cathode ray tube in real and relative target motion modes. This same firm produces the CSU-83 sonar complex. It has channels for passive sonar, for determining distance to the target by the passive and active method, and for detecting and processing sonar signals. Separate cylindrical arrays are used for emitting and receiving signals, and antennas spaced on both sides are used for automatic tracking. This system includes an active sonar (frequency 8 kHz, effective range 9 km), a sonar signal detection set (1-100 kHz, 90 km), a passive panoramic sonar (0.3-12 kHz, 18 km), gear for determining target motion (0.01-2 kHz, 45 km), and for determining range to target (2-8 kHz, 15 km), a sonar with towed antenna array (0.01-0.8 kHz, 90 km), and a device for measuring internal noise (0-12 kHz). The complex is a component of the ISUS integrated tactical system and is manned by four operators.

Great Britain has developed the COMTASS sonar with towed uniform linear array for submarines with a displacement over 500 tons. According to Plessey specialists, this set is distinguished by compactness and modularity of design and relatively small weight of the antenna deployment and retrieval device (no more than 3.5 tons). The uniform linear array (diameter of 63 mm) is 80-130 m long and contains highly sensitive low-frequency hydrophones and is towed by a tow cable 25 mm in diameter and up to 1,500 m long. Overall weight of antenna and cable does not exceed 2.6 tons. The signal processing device is made with microprocessors. According to western press data, with this sonar the detection distance of a ship can be 50-185 km depending on hydrological conditions.

The use of piezoelectric polymers including polyvinylidene fluoride (PVDF) for conformal antennas is considered one of the promising directions for improving sonars. The thin film (0.1-0.5 mm) made from PVDF plays the role of active material in hydrophones. Work is being done in this area by American, British and Japanese specialists.

Torpedoes remain the basic weapon of diesel submarines. They are being improved in the direction of an increase in range and speed. Wire control provides such a high kill probability that in a number of cases one torpedo is enough to destroy a target. Modern systems for storage and for reloading torpedo tubes provide rapid reloading: for example, six tubes are reloaded in 15 minutes in a Type TR 1700 submarine.

Some foreign specialists believe that just as the appearance of antiship missiles promoted an improvement in effectiveness of antiaircraft missile and gun systems aboard surface combatants, an improvement in antisubmarine torpedoes will lead to the creation of fast-response antitorpedo weapons in submarines. The possibility of equipping submarines with underwater-launched antiaircraft missiles for combating low-flying antisubmarine aircraft is being studied. The Harpoon and Exocet antiship missiles accommodated in submarines increase their tactical capabilities, but an antiship missile's exit from the water directly at its launch point permits detecting a submarine. Therefore in the opinion of FRG specialists it is necessary to develop a missile which would cover a considerable distance under the water after launch and surface at a great distance from the submarine.

Minelaying is considered one of the typical missions of submarines and is accomplished by means of torpedo tubes. Some of the torpedoes usually are replaced by mines for minelaying, and capabilities for making torpedo attacks then are reduced. As the foreign press reported, external containers for transporting and laying mines have been adopted for West German submarines. They are made of glass-reinforced plastic and low-magnetic steel, are designed for the submarine's operating depth, have a streamlined shape, and one is attached to each side. The container is 11.5 m long, 1.6 m wide, 3.6 m high and weighs 5 tons without mines. It consists of 12 cells which accommodate mines up to 3.1 m long and 0.54 m in diameter. Mine preparation and opening of the cells' bottom covers are cable-controlled. Mines are laid at a speed up to 12 knots. If necessary the containers can be jettisoned and flooded. Western specialists believe that they have an insignificant effect on the submarine's running and maneuvering characteristics. For example, speed is reduced by 1.5 knots. Similar devices also are being developed in other countries such as in Sweden.

The power plants of modern diesel submarines have seen further development. Double-armature propulsion motors with up to 7,500 kw output and a frequency of revolution of 200 rpm are being installed in submarines of West German production. They are distinguished by a low noise level, achieved by reducing the number of revolutions, eliminating the reduction gear from the shaft line, using plain ring-oil bearings and periodically engaging the ventilation depending on armature temperature. It is planned to use thyristor engine-control rheostats to further reduce noise in the future.

Improved high-rpm four-cycle diesels equipped with a supercharger with mechanical drive are widely used. They have a low weight-to-power ratio (19 kg/kw), which permits installing several engines at the same time. This ensures high output for charging batteries, considerably reduces charging time and guarantees power redundancy. The 16-cylinder Paxman Valenta engine (cylinder diameter 197 mm) fitted with a supercharger with mechanical drive can serve as an example of a modern submarine diesel. The engine was developed for "Upholder" Class submarines being built in Great Britain. The rotating frequency of the supercharger impeller is 24,000 rpm in order to obtain the necessary degree of pressure increase. A further reduction of the weight-to-power ratio of diesels as well as of fuel consumption became possible with the introduction of turbosuperchargers operating on exhaust gases. They are characterized by a turbine and compressor combination with gas tightness between them provided by special seals. Tests have shown that the turbosupercharger operating on exhaust gases is fully suitable for operation in submarines under conditions of reduced air intake pressure and high exhaust backpressure. (In nonsupercharged engines the output required for removing exhaust gas with backpressure represents a considerable portion of engine output.)

The characteristics of selected types of modern submarine diesels are given in the table.

Turbosupercharged diesels reduce fuel consumption by 10 percent or more. Therefore it is believed that over the next decade they will hold a leading place in submarine diesel generator plants.

Generators included in submarine main power plants have to meet a number of specific requirements: produce direct current for charging batteries, for propulsion motor power and everyday needs; and operate with maximum power to reduce snorkelling time and operate at high efficiency under partial load. For many years submarines have been fitted with dc generators but as early as the late 1960's the Netherlands, Great Britain, France, Sweden and the FRG began to shift to synchronous ac generators with built-in rectifiers. Such generators require less complicated maintenance, are highly reliable, combine well with the high-rpm diesels of new designs and have a higher efficiency and lower weight-to-power ratio. For example, while the output of dc generators put out in the FRG by AEG in the 1960's was 405 kw with a weight-to-power ratio of 6.5 kg/kw, the

Type Diesel, Country	Output, kw / rpm	Power-to-Weight Ratio, kw/kg / Specific Power, kw/l	Fuel Consumption, g/kw-hr: At 100% Power / At 35% Power	Weight, kg / Kind of Supercharging
12V652MB,	950 / 1400	0.14 / 12	280 / 345	6600 / Mechanical
16V396SB,	940 / 1800	0.17 / 15	235 / 325	5600 / Turbo
V12A15Ub,	810 / 1500	0.11 / 12	255 / 360	7200 / Turbo
12VPA4V185VG,	770 / 1300	0.11 / 11.5	320 / •	6850 / Mechanical
16RPA200SZ.	1518 / 1350	0.17 / 14.5	280 / •	9000 / Mechanical

ac/dc generator created by Siemens in 1982 for the Type TR 1700 submarine has an output of 1,210 kw with a weight-to-power ratio of 4.4 kg/kw.

The propulsion motors of modern submarines usually are characterized by an output of 3,500-4,000 kw. A synchronous motor with an output of up to 10 megawatts with permanent-magnet excitation (Fig. 3 [figure not reproduced]) is considered to be the next-generation propulsion motor for submarines of West German construction. Its use of multiphase converters provides for highly efficient speed control. Rotational speed can be reduced to 120 rpm. Main power plants with an automated air-cooling system have a higher efficiency, which increases submerged endurance, and they have a low noise level inasmuch as outside water under pressure is used less.

The capacity of storage batteries both with lengthy and brief charging has considerably increased in recent years because of the use of tubular and double-flow cells, an increase in acid concentration and other technological solutions.

The foreign press notes that lead-acid batteries make up 20-25 percent of a submarine's weight, operate at a temperature of around 30 degrees Centigrade, can function for seven years or more, and are characterized by an energy capacity of from 22 watt-hr/kg with a one-hour discharge mode to 55 watt-hr/kg with a 100-hour discharge mode. Their further improvement will permit a 30 percent improvement in specific watt-hour capacity in the very next few years with large-current discharge.

Silver-zinc batteries have a guaranteed service life of 2.5 years or 300 cycles and a watt-hour capacity of around 130 watt-hr/kg, but they are four times more costly than lead-acid batteries. A number of countries are studying the use of sodium-sulfur batteries on submarines. The foreign press reports their following characteristics: watt-hour capacity 300-350 watt-hr/kg, service life around 10,000 cycles, operating temperature 300 degrees Centigrade. According to calculations of West German specialists, outfitting Type 209 submarines with such batteries will increase the length of submerged operation in the high and low speed range by 4.5 and 2.5 times respectively. Prior to practical introduction of these batteries aboard submarines, however, a number of problems must be solved, above all how to regulate cooling and heating of the batteries depending on a change in the load.

Sweden has conducted tests of lithium thionyl chloride batteries as an auxiliary energy source for "Naecken" Class submarines. As indicated above, the ratio of snorkelling time (to recharge storage batteries) to the time of submerged operation is one of the basic characteristics of diesel submarines. Foreign literature calls this ratio the "detectability coefficient." It can be 18-20 percent in a transit at a speed of 8-10 knots and 6-7 percent in the period when the submarine is on station. Snorkelling sharply increases the likelihood of a submarine's detection: the operating diesel increases noise emission and the raised snorkel can be detected visually as well as by radar, infrared or other means.

The concealment of submarine operations can be improved by their use of power plants operating without entry of atmospheric air (anaerobic). They include Sterling engines and fuel cells and diesels with a closed operating cycle.

Swedish specialists concentrated efforts on developing Sterling engines, or engines with external heat absorption. Their design provides for the presence of a common combustion chamber for all cylinders and use of double-acting pistons which perform the functions of a working piston and displacer. The fuel can be any kind and liquid oxygen is used as an oxidizer. The engines conform to

modern diesels in efficiency but are inferior in power (around 100 kw). This circumstance dictates their use in submarine combination power plants as an auxiliary component providing, if necessary, a considerable increase in time between routine surfacings to recharge batteries.

For a practice check of power plant characteristics based on the Sterling engine the Swedish firm of Kockums created a full-scale power compartment 5.6 m in diameter and some 7 m long. The western press notes that after the tests a decision was made to equip one of the existing "Naecken" Class submarines with this engine.

The French firm of Comex built and is conducting trials of the submarine "Saga-1." She is fitted out with two V4-275 Sterling engines which are assumed to give her a submerged speed of 6 knots. The diesel is used in a surface condition. The submarine is intended for scientific research and underwater work. She has a crew of seven and in addition a special compartment accommodates six skindivers. The submarine's submerged endurance is 15 days. Up to 3 tons of equipment and instruments are taken aboard to perform work. In wartime the submarine takes aboard frogmen in place of the skindivers.

It is planned to take account of experience in developing and testing the "Saga-1" in creating the "Saga-2" combat submarine for coastal operation. The firm's specialists believe that this submarine, which has a displacement of 340 tons and is fitted with an anaerobic power plant, will be of interest for small countries above all. She will be armed with eight 533-mm torpedo tubes (six forward and two stern) and will be able to take aboard up to eight MCC23 mines or the equivalent. She has a crew of 12 and an endurance of 1,800 nm. In addition to making torpedo attacks and laying mines, she is to be used for transporting reconnaissance-sabotage groups.

The West German firms of IKL, Howaldtswerke Deutsche Werft and Siemens completed development of a power plant based on oxygen-hydrogen type fuel cells. The energy of the fuel oxidation reaction is converted in them directly into electrical energy. Hydrogen stored in the form of metallic hydrides serves as the fuel and liquid oxygen as the oxidizer. The plant consists of 16 fuel-cell units each with 25 kw of output. After completion of ground tests a decision was made to fit out one of the existing Type 205 submarines with this plant. The submarine U1 (displacement 450 tons) was docked in March 1987; here an additional section will be added to her. It is believed that the fuel cells will provide for a lengthy submerged speed of 3-4 knots. Sea trials of the submarine with combination main power plant should begin in November 1987. As the foreign press notes, their results may have a substantial influence on projects of submarines of the following generation.

According to calculations by Thyssen Nordseewerke experts, a diesel submarine with anaerobic power plant and displacement of 1,800 tons may be created as early as the next few years with the following characteristics: maximum submerged speed for an hour of 25 knots, submerged endurance 500 nm at a speed of 5 knots and 80-percent discharge of batteries, submerged depth of more than 300 m, and endurance of 70 days.

Realizing that the combat effectiveness of submarines depends to a considerable extent on the personnel's psychological and physical state, western military specialists are giving much attention to an improvement in their habitability conditions, which are largely determined by the size of the area per crew member. By increasing the degree of automation it is possible to reduce crew size and accordingly improve this indicator, but it takes into account the minimum number of persons necessary for manning equipment and spaces, and chiefly for manning battle stations in critical situations. The area norm per person for submarines of the modern West German Type TR 1700 is 2.5 m^2.

It is planned to make vital systems and sets of equipment redundant for the operating safety of submarines. To rescue the crews of submarines in distress wide use is made of the method of free-buoyancy escape from a depth down to 80 m with the help of a life vest and down to 150-180 m using a rescue suit and undergoing pressure equalization in an airtight access well specially adapted for this. In a free-buoyancy escape the overall time a submariner remains under pressure must not exceed the limit after which decompression is required (up to 30 minutes at a pressure of 3 atmospheres and around 5 minutes at a pressure of 7 atmospheres). Rescue operations are possible at greater depths (right down to collapse depth) using rescue submersibles. Such operations can last for 4-6 days.

It is planned to expand capabilities of rescue systems on future submarines. In particular, it is recommended that even aboard submarines of small displacement a watertight bulkhead be installed without fail that is just as strong as the hull and divides it into two compartments. This makes it possible for the crew in an undamaged compartment to fight for their rescue. Both compartments must have means of docking with the rescue submersible and provide for the possibility of free-buoyancy escape.

Another project provides for fitting out a submarine with an integral spherical escape chamber which is mounted on a bulkhead and is intended for receiving personnel from adjacent compartments (Fig. 4 [figure not reproduced]). The locking mechanism is released after the crew is accommodated in the chamber and it rises to the surface. The advantage of that system is that it allows getting by without rescue vessels and making an ascent without the harmful effect of pressure on people. The first models of such a rescue system have been installed on submarines built in the FRG. The spherical chamber

(weight 13 tons, diameter 2.6 m) can accommodate up to 40 persons. The chamber was separated at a depth of 80 m during tests. The rate of ascent with a full load was 1.2 m/sec. The locking mechanism functioned with a trim of 45 degrees and a list of 60 degrees.

A system of hydrazine gas generators installed in ballast tanks and providing for their extremely fast blowing at any depth was developed for West German submarines and has been tested. After emergency surfacing of a submarine the crew can then abandon her on the water's surface if necessary.

In the opinion of foreign specialists, realization of the above basic directions for the development of diesel submarines will permit them not only to retain but also strengthen their position in the order of battle of the fleets of capitalist states over the next 20-30 years.

Footnote

*For the beginning of the article see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 10, 1987, pp 53-57—Ed.

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Principal Iranian Communication Routes and Ground Transportation

18010065k Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 11, Nov 87 (signed to press 4 Nov 87) pp 70-76

[Article by Lt Col Ye. Gromov]

[Text] Judging from foreign press reports, a growing volume of transport movements (a considerable portion of which presently is in support of combat actions against Iraq) is forcing the Iranian leadership to take vigorous steps to improve the country's transportation system (Fig. 1). Principal attention is being given to augmenting the transportation equipment pool through purchases of new equipment abroad and adjustment of domestic production of such equipment, and to further improving the road network and pipeline transport. According to foreign press data, each year an average of over 12 percent of the total volume of capital investments in Iran is allocated to these objectives.

Meanwhile the continuing armed conflict with Iraq is having a negative effect on the condition and further development of ground transportation. The damage done to it in the course of military actions as of the beginning of 1985 has been assessed by Iran's ministry of roads and transport at approximately $4 billion. Difficulties in supplying fuels and lubricants, increased prices on them on the domestic market, an absence of Iran's own developed industrial base for manufacture and repair of transportation equipment, curtailment in activities of foreign companies which had been taking part in building installations of Iran's infrastructure, and the departure of a large number of foreign specialists also are having an effect on the operation of transport.

Motor transport plays the primary role in transporting passengers and freight in the country; it accounts for around 60 percent of the total volume of movements. As of 1987 some 600,000 pieces of motor transport equipment were in operation in domestic transportation, including 160,000 light trucks, 135,000 other trucks, 70,000 buses and microbuses, 210,000 taxis (including freight taxis), and 25,000 leased passenger vehicles. In addition, foreign transport companies play a certain role in this kind of service. For example, in 1986 around 250,000 motor vehicles passed through Iran's border points which carrying over four million tons of freight (according to Iranian press data the total volume of domestic freight shipments by motor transport is 110-140 million tons per year).

The motor vehicle fleet basically includes West German, Japanese and Swedish vehicles. Intensive operation under adverse climatic and geographic conditions and difficulties in spare parts supply and maintenance mean that a considerable portion of the equipment (over 12 percent) is constantly unserviceable. Until recently the average growth rates in the number of trucks counting domestic production (assembly on the basis of assemblies purchased abroad) and imports made up around 3,500 units per year. In the opinion of foreign specialists this did not permit fully meeting the country's growing motor transport needs. With passage of the law on import-export regulation in April 1986 substantially limiting the import of trucks and passenger vehicles from abroad (restrictions do not extend to the ministry of defense), local economists believe that the growth in Iran's motor vehicle fleet will be cut almost in half.

Motor transport is given an important place in military movements. According to published statistics, around one-third of Iran's operational motor vehicle equipment supports combat actions of the Armed Forces. Motor vehicles belonging to civilian departments deliver over 50 percent of the armament, supply items and personnel to combat zones daily. Over 80 percent of roadbuilding equipment (bulldozers, dump trucks, loaders, asphalt pavers) is used in Iran-Iraq front areas for building lines of communication and for other engineer work.

The priority status and significance of motor transport movements in the country's transportation system presume heightened attention of Iranian authorities to development of the highway network, of which over 8,000 km have been built and some 6,500 km improved since 1979. Among the new roads are the Firuzkuh, Zirab, Qaemshahr; Gorgan, Azadshahr; Sari, Behshahr; Mianeh, Qareh Chaman, Andimeshk, Dashtabbas; and Andakan, Yasuj, Baba Medan roads. In 1987 it is planned to complete the job of asphalting sections of the

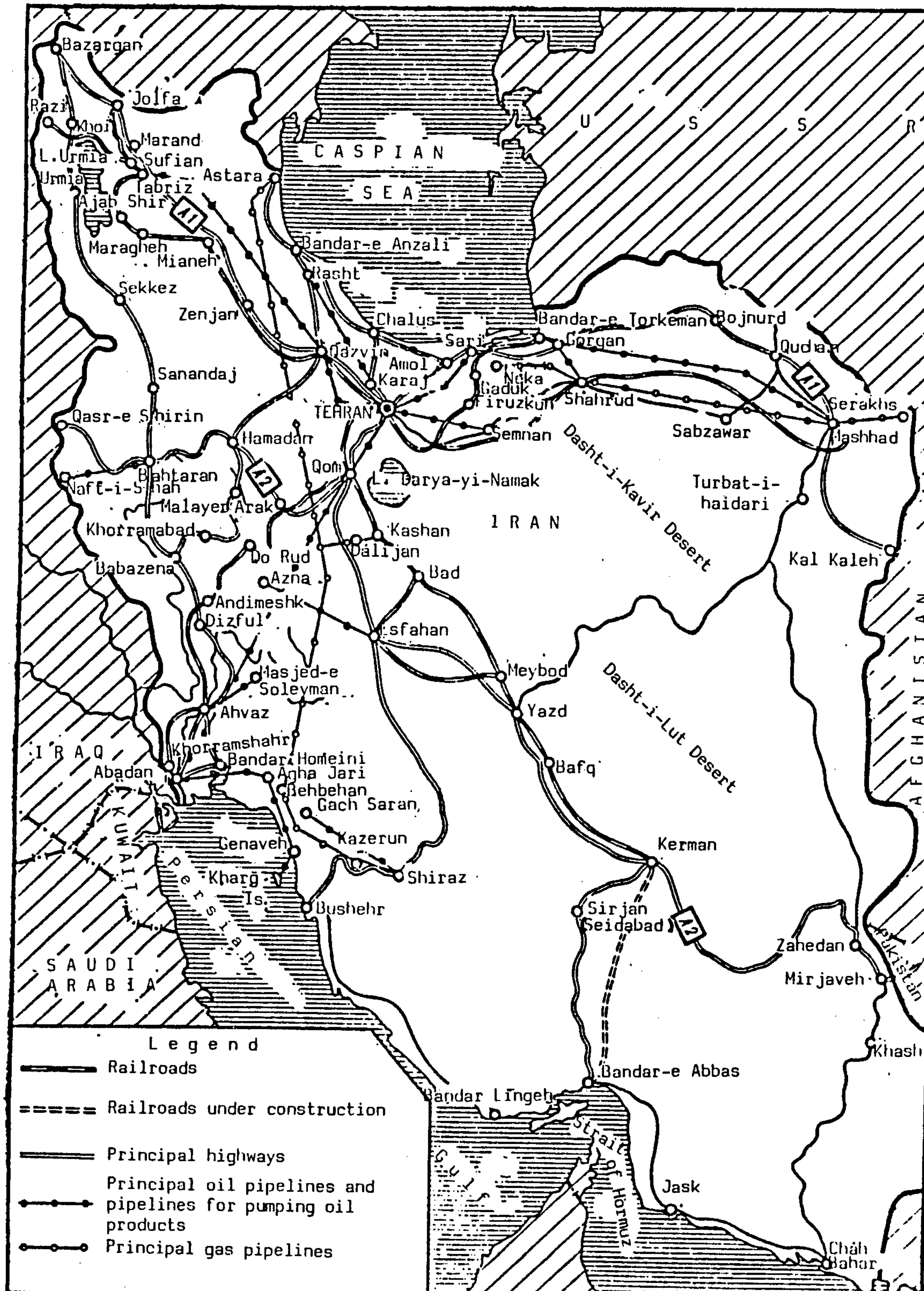

Fig. 1. Diagram of Iran's principal transportation routes

Takestan, Zenjan, Mianeh, Qareh Chaman; Eslamabad (55 km southwest of Bahtaran), Ilam; and Andimeshk, Ahvaz roads and complete construction of a causeway across Lake Urmia.

The currency and financial difficulties which the country is experiencing had a negative effect on highway construction rates. At the present time the ministry of roads and transport is working only on those road facilities where construction began earlier, with at least 25-30 percent of the planned volume already completed. Capital investments for construction and planning of new roads are not envisaged for now.

The total length of the country's highways (as of the beginning of 1987) exceeds 60,000 km (including some 20,000 km with hard surface) and their average density was 3.6 km per 100 km^2, which is considerably below similar indicators for the majority of world countries. The road network is unevenly distributed, with the bulk being in the economically developed and densely populated northwestern and southwestern parts of Iran. Difficult deserts and mountain ranges in the central and southern parts of the country are crossed by individual highways which are hundreds of kilometers apart. Motor routes run across high mountain passes and along narrow gorges, canyons, galleries and tunnels. In winter in the mountain passes they are often drifted with snow and in spring they are destroyed by mud slides and rock slides. The mountain upgrades and downgrades have a large number of serpentines with hairpin turns and constrictions. Lengthy upgrades and downgrades reach 30-40 km.

The predominant roadbed width of hard-surface roads is 6-11 m and the roadway is from 5 to 8 m wide. The majority of roads are suitable for two-way motor traffic. An exception are individual sections in mountainous terrain where the width sometimes is not over 2-3 m. Gravel and crushed rock are primarily used as surfaces, and bituminous binder sometimes is used. Highways are kept in satisfactory operating condition as a rule.

Two international trunk highways A1 and A2 run across Iranian territory connecting the country with Turkey and Iraq in the west and Afghanistan and Pakistan in the east.

International trunk highway A1 (Fig. 2 [figure not reproduced]) runs along the route Bazargan (Iranian-Turkish border), Marand, Tabriz, Tehran, Amol, Bojnurd, Mashhad, Tajabad, Kal Kaleh (Iranian-Afghan border). It was placed in operation in 1972 after completion of construction of new sections and improvement of existing sections of the road. It is 2,142 km long, roadbed width is 11 m, and it has a large number of manmade facilities—bridges, tunnels, viaducts. As a rule they are built in mountainous sectors, the most difficult of which are the Jam Pass (1,782 m above sea level), a pass at 2,105 m above sea level, the Qaflan Kuh Gorge, the Haraz Mountain Passage, and the Emamzadeh-Hashem (2,718 m) and Ak Kotal (1,050 m) passes. From Tehran the road heads for the Caspian coast and further to the east it runs along the Iranian-Soviet border at a distance of 50-70 km. Motor transport is allowed to travel at a speed of 90 km/hr.

International trunk highway A2 (2,507 km) runs from the Iraqi border through the populated points of Qasr-e Shirin, Bahtaran, Tehran, Qom, Esfahan, Kerman, Zahedan, Mirjaveh to the border with Pakistan. The highway has an asphalt surface and the roadway is 7-8 m wide. The most difficult sectors are considered to be the pass at 1,540 m above sea level, the Chahar-Zebar Pass (1,654 m), the Gerdan-i-Bidsurh Pass (1,715 m) and the pass at 2,207 m.

The country also has built several main highways of national importance. The Bazargan, Khoi, Urmia, Sekkez, Sanandaj, Bahtaran, Dizful, Abadan (1,200 km) highway has an asphalt surface 6-8 m wide. The most difficult is the Sekkez, Bahtaran section, which intersects the northern spurs of the Zagros Mountains. The 286-km Dizful, Abadan sector is convenient for motor transport traffic. Passenger vehicles can develop a speed here of up to 100 km/hr and trucks up to 70 km/hr. The highway has important military-economic significance. The asphalt surface on the Bandar-e Anzali, Qazvin, Hamadan, Malayer, Khorramabad, Abadan main highway (1,283 km) is 6-8 m wide. The most difficult is the sector 205 km long cutting across the Zagros Mountains. The Astara, Chalus, Amol highway (410 km) runs along the Caspian coast. The width of this roadway is 5-8 m and it has an asphalt surface. The asphalted Esfahan, Shiraz, Kazerun, Bushehr highway (795 km) has a roadway 7 m wide. The main Kerman, Sirjan (Saidabad), Bandar-e Abbas highway (560 km, asphalt surface 7-8 m wide) allows a traffic speed of 70-80 km/hr. Among the most difficult sectors are the following: 189 km south of Sirjan (a tunnel around 1 km long), the Chah-e Chegek Pass (1,893 m above sea level), four tunnels each 100-180 m long and two tunnels each 800 m long near the populated points of Hajjiabad and Abedin. The width of the roadway of the Tehran, Karaj, Chalus highway is 6-6.5 m. It has a difficult profile: there are many sharp turns, manmade facilities and narrow gorges. There is some difficulty in crossing the Kandovan Pass (3,000 m above sea level). A highway tunnel some 2 km long has been built under the pass at an altitude of 2,670 m. The distance between end points is 193 km and there is an asphalt surface for the entire length. The Tehran, Qom freeway (125 km) has two separated multiple lanes, each 11 m wide allowing three lanes of motor transport traffic in each direction.

In addition, Iran has a large number of secondary roads linking small populated points with each other and with the republic's administrative centers.

According to official statements by Iranian authorities, further development of the highway network will chiefly involve repairing and improving existing roads (basically

in the combat zone and near the Iranian-Pakistani border). It is planned to equip the vehicle fleet with modern equipment, arrange for its uninterrupted supply of spare parts and proper maintenance, and introduce elements of sector control with the help of computer technology.

Rail transport accounts for some 15 percent of all domestic shipments. Railroads and rolling stock are state property and their operation is assigned to the State Railway Office of the Iranian ministry of roads and transport. More than 30,000 persons are employed in the rail transportation system. By the end of 1985 the total length of Iran's railroads reached 4,600 km (of which 145 km are electrified) and their average density is around 0.3 km per 100 km^2. The country has adopted a track gauge of 1,435 mm, with the exception being the 94-km Zahedan, Mirjaveh railroad with a 1,676-mm gauge.

Railroads basically are single-track. In the majority of cases their throughput is 10-16 pairs of trains per day. The condition and profile of the railway bed allows the movement of freight trains weighing 400-800 tons (with double traction up to 1,000 tons) at an average speed of 30-40 km/hr (passenger trains 45-50 km/hr).

A characteristic feature of Iran's railroads is the difficult route profile, except for some sections of plains in coastal areas of the Persian Gulf and Caspian Sea; a significant number of curves of maximum permissible radius; a weak railway bed; and a large number of manmade facilities. For example, the Luristan sector (Qom, Khorramshahr) has 177 tunnels with a total length of 58.5 km, and the Northwestern sector (Tehran, Tabriz, Jolfa) has 47 tunnels (16.1 km).

According to foreign press reports, at the beginning of 1987 the country's locomotive fleet numbered more than 650 diesel and electric locomotives purchased at various times in the United States, France, Japan and Romania; 14,300 freight cars; and around 1,000 passenger cars. A plant for producing reinforced concrete cross ties (city of Andimeshk) with a capacity of up to 700,000 ties per year and the Pars Railcar Building Plant (city of Arak) designed for manufacturing up to 1,000 cars annually were placed in operation in the country in 1984. It is planned to install a line at the plant for performing major overhaul and medium repair of railcars and by 1990 to adjust production of passenger cars and diesel locomotive bogies.

The country's main railway line is the first section of the trans-Iran railroad 1,392 km long built in 1938. It connected Tehran with the port of Bandar-Homeini in the south and the Caspian port of Bandar-e Torkeman in the north, from which a branch line 36 km long was laid in 1959 to the city of Gorgan. The Tehran, Firuzkuh, Bandar-e Torkeman, Gorgan railroad (496 km) cuts across the Elburz Range. It has some 2,000 bridges and 93 tunnels for a total length of 24 km. The largest of them (Gaduk) is 2,887 m long. The southern part of the trans-Iran mainline runs across the Central Iranian Mountains, the Zagros Mountains and further on along the Khuzistan Valley. The most difficult is the Do Rud, Andimeshk sector (208 km), where there are over 680 bridges and some 120 tunnels 58.5 km long.

A number of branches run off the mainline. The Tehran, Tabriz, Jolfa railroad (882 km) linking Iran with the Soviet Union runs to the northwest. Its daily throughput is 10-16 pairs of trains. The permissible speed of freight trains is 35-40 km/hr. The Daradiz Gorge (8 km long) and Qaflan Kuh Gorge (10 km), a 10 km section northwest of Ajab Shir in which there are six tunnels, and the 55-km section in the Qaranqu River Valley (10 km west of Mianeh) where 14 bridges and 31 tunnels are built for a total length of 11.4 km, are the most difficult for traffic. The Sufian, Razi railroad branch line (190 km) connecting Iran with Turkey runs from the city of Sufian (30 km northwest of Tabriz). The 26-km leg in the Qotur River Valley in which there are 33 tunnels with a total length of 10.8 km and a bridge across the river is the most difficult in this part.

The country's northeastern areas are connected with the trans-Iran mainline by the Tehran, Mashhad railroad (925 km). The railroad basically runs along flat terrain with the greatest elevation above sea level being 1,666 m. The throughput is 10-16 pairs of trains a day and the average speed of freight trains is 30-35 km/hr (passenger trains 40-50 km/hr).

The Tehran, Ahvaz, Khorramshahr and Ahvaz, Bandar Homeini railroads 937 and 110 km long respectively link the capital with the naval base and port of Khorramshahr as well as with the oil exporting port of Bandar Homeini on the shore of the Persian Gulf. The railroads' throughput is 12-16 pairs of trains a day. The average traffic speed is 30-40 km/hr. The roads' profile is difficult, with a large number of tunnels, bridges and vertical rock walls along the route. One of the largest bridges on Iran's railroads (1,060 m long) is in the vicinity of Ahvaz across the Karun River.

The central parts of Iran are connected with the country's southeastern areas by the Qom, Yazd, Kerman railroad (around 800 km). In the future it is planned to extend the railroad to the city of Zahedan, which will permit establishing rail traffic between central parts of the country and Pakistan. In addition to the above railroads, Iran has the Zahedan, Mirjaveh; Meybod, Esfahan Metallurgical Combine (290 km); and Bad, Esfahan (160 km) railroad lines.

Further development of rail transport is envisaged by the first five-year plan for social-economic and cultural development of the Islamic Republic of Iran for fiscal years 1983/84-1987/88, in accordance with which it is planned to place around 900 km of new railways in operation, to construct second tracks in the Tehran,

Qom and Ahvaz, Bandar Homeini sectors and to build a circumferential railroad around Tehran for relieving the load on the capital's rail junction.

One of the most important five-year plan projects is to place in operation the Bafq, Kerman, Bandar-e Abbas railroad 631 km long, which will permit exporting cargoes from the port of Bandar-e Abbas. Some $400 million have been allocated to carry out the project. Companies and construction organizations from Japan, Italy, China and other countries are taking part in implementing it. The railroad is being built with consideration for modern requirements and is calculated for passenger trains moving at a speed of up to 160 km/hr, and freight trains up to 100 km/hr. A double track is being built from Bafq to Gol-Gohar, and further on to Bandar-e Abbas one track will be laid temporarily because of the difficult terrain relief. Subsequently it is planned to electrify the entire mainline.

According to long-range plans published by the Iranian State Railway Office, it is planned to build the Enzeli, Qazvin; Qom, Qasr i Shirin; Andimeshk, Bahtaran, Sanandaj, Maragheh; Mashhad, Zahedan, Chah Bahar; and Bandar-e Abbas, Bandar Homeini railroads. With the completion of these and other lines the total length of Iran's railroads will exceed 14,000 km.

Pipeline transport plays an important role in the country's economy. Iran is one of the largest exporters of oil and natural gas to countries of Western Europe as well as to Turkey, Japan and a number of other countries. It holds third place in the capitalist world based on explored oil reserves. The southwestern part of the country, where the largest oilfields of Masjid-i-Sulaiman, Haft Gel, Agha Jari and others are located. Considerable oil reserves also are located in the Persian Gulf area. The bulk of crude oil (75 percent) is exported through ports of Abadan, Kharg and others, to which it is pumped over pipelines. In the estimate of the foreign press, each year up to 70 percent of the oil and oil products produced is transported over pipelines in the country, with the total length of main pipelines being approximately 9,000 km, including around 4,000 km of oil pipelines and 2,400 km of pipelines for transporting oil products (often called product pipelines).

The densest network of *oil pipelines and product pipelines* is laid in the southwestern part of the country and on the shore of the Persian Gulf. They connect oilfields with oil refineries and ports as well as refineries with nearby consumers. Systems for automatic control of pumping and control of the movement of oil and oil products are installed at pumping stations.

At the present time Iran is operating six main pipelines (Table 1). The Abadan, Tehran product pipeline links the largest oil refinery in Abadan with Tehran. Its route has a difficult profile and basically runs along the Abadan, Ahvaz, Tehran highway. The Ahvaz, Tehran oil pipeline has been built parallel to it, and along its route

Pipelines	Length, km	Pipe Diameter, mm	Number of Lines	Throughput Flow Capacity millions of tons/year
Abadan, Tehran	949	305; 254	1	2,2
Ahvaz, Tehran	754	508; 406	2	4,2
Tehran, Mashhad	850	203	1	0,68
Tehran, Rasht	330	203; 152	1	1,2
Tehran, Tabriz	550	356	1	•
Gach Saran, Shiraz	330	254	1	•

15 pumping stations have been built which also serve the product pipeline. The Tehran, Mashhad product pipeline has been built to supply oil products to the country's eastern provinces. It runs basically over flat terrain along the highway connecting these cities. Pumping stations with POL depots have been built in the cities of Semnan, Shahrud, Gorgan and Mashhad. The Tehran, Rasht product pipeline transports oil products from the Tehran refinery for industrial needs as well as for units and subunits of the Armed Forces in Iranian Azerbaijan. The pipeline runs along the highway. Pipes are laid in the ground to a depth of 1 m and they are laid in specially built crossings over gorges and rivers. Pumping stations and POL depots exist in the cities of Qazvin and Rasht. Because this product pipeline ceased to meet the increased needs for oil products, an oil refinery with a capacity of 12,000 tons of finished products per day has been built in Tabriz. The Tehran, Qazvin, Tabriz oil pipeline runs up to it parallel to the highway.

The Shiraz oil refinery (capacity of around 6,000 tons of oil products per day) is linked with the Gach Saran field by the Gach Saran, Shiraz oil pipeline.

In addition to the above mainlines the country has another 12 most important nonmain pipelines, characteristics of which are given in Table 2.

Iran also holds one of the first places in the capitalist world in natural gas reserves. They comprise around 5,700 billion m^3 (approximately 17 percent of all explored reserves in the capitalist world). Natural gas production in 1985 was seven billion cubic meters. Its basic reserves are concentrated in the south. In recent years a major gas field has been developed in the northeast near the city of Sarakhs. *Gas pipelines* are widely used for transporting natural gas.

The Behbehan, Astara trans-Iranian gas pipeline 1,105 km long was placed in operation in 1970. Natural gas is supplied over it from southern gas regions to the northern part of the country. The route runs over terrain with

Pipelines	Length, km / Number of Lines	Pipe Diameter, mm	Throughput Flow Capacity, Mill. tons/yr
Agha Jari, Genaveh	210 / 3	1067	150
Gach Saran, Genaveh	120 / 2	660; 711; 762	110
Genaveh, Kharg Island	43 / 5	762	180
Abadan, Bandar-e Mah Shahr	112 / 4	305; 660	24
Abadan, Ahvaz	121 / 2	100; 203	0.35
Agha Jari, Abadan	65 / 6	305; 406; 660	*
Masjed-e Soleyman, Ahvaz	98 / 1	254	*
Naft-i-Shah, Bahtaran	240 / 2	150; 100	0.6
Azna, Esfahan	234 / 1	152	0.3
Gach Saran, Bandar-e Mah Shahr	140 / 1	*	*
Bandar-e Mah Shahr, Genaveh	200 / 1	*	*
Tehran, Sari	220 / 1	*	*

difficult mountain relief. In the Zagros Mountains it is laid at an altitude up to 3,000 m and intersects the Elburz Range at an altitude of around 2,000 m above sea level. This gas pipeline is served by eight compressor stations. To supply cities located near the pipeline with gas there are branches off it from Behbehan to Shiraz (322 km long with a pipe diameter of 306 mm), from Dalijan to Kashan (70 km and 165 mm) and others.

In addition to the trans-Iranian gas pipeline and branches from it, small gas pipelines of local significance have been built in the areas of gas fields.

The Sarakhs, Mashhad, Neka oil pipeline around 800 km long (pipe diameter 750 mm) has been built along international trunk highway A1 in connection with development of gas fields in the eastern part of the country and the need to transport it to central areas.

As the western press notes, despite serious economic and currency-financial difficulties existing in Iran, the government continues to devote attention to further development of the pipeline system. Preference is given to building those infrastructure installations which would be able to support functioning of the economy and uninterrupted oil export under conditions of the continuing Iran-Iraq war. For example, according to foreign press data Iran has developed a project for building the Shiraz, Jask oil pipeline (along the shore of the Gulf of Oman), in accordance with which it is planned to build two lines with a total throughput flow capacity of up to 320,000 tons per day. The desire also is noted to arrange for exporting oil to the Mediterranean across the territory of Turkey.

Exploration and planning work were completed in 1986 in accordance with the Iranian-Turkish agreement on the route of future oil and gas pipelines which are to be built from oil regions of Iranian Khuzistan to the Turkish port of Iskenderun on the Mediterranean coast. The throughpout flow capacity of pipelines 1,900 km long will be around 55 million tons of oil and 50 billion m^3 of natural gas per year. It is planned to complete construction in 1990. In building the oil pipeline it is planned to use some of the pipelines already existing in Iran with their partial modernization.

Judging from data cited in some foreign economic publications, the status of Iran's ground transport on the whole meets the economy's development rates. The network of highways and railroads, the pipeline system and the fleet of transport equipment is expanding in the country. Meanwhile the continuing Iran-Iraq conflict is having a negative effect on the development of transport.

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LAV-25 Light Wheeled Armored Vehicle

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[Article by Col N. Fomich]

[Text] U.S. Marine subunits will have LAV-25 light wheeled (8x8) armored vehicles in the inventory. It is planned to deliver 758 units, including special-purpose vehicles (command and staff, transport, recovery, self-propelled antitank missile systems and 81-mm mortars. The prototype of a self-propelled antiaircraft mount with combination missile-gun weaponry also has been created at the present time.

The LAV-25 (see figure [figure not reproduced]) is the Swiss Piranha wheeled APC with an American two-place armored turret mounted on it. It is produced in Canada by General Motors of Canada. The closed armored hull protects against bullets and artillery shell fragments. In addition to three crew members, the assault compartment accommodates six fully equipped Marines.

The vehicle is armed with a Bushmaster M242 25-mm automatic gun with a coaxial 7.62-mm machinegun. It has a unit of fire of 210 gun rounds and 420 machinegun cartridges. The commander and gunner have periscopic sights. Two four-barrel grenade launchers are mounted in the front part of the turret for laying smoke screens.

A six-cylinder 6V-53T 275 hp diesel engine mounted in the front right part of the hull is used as the power plant. An Allison MT-653DR automatic hydromechanical transmission is connected with it. The four front wheels have independent coil spring suspension with hydraulic shock absorbers and the rear wheels have torsion-bar suspension. Movement afloat (at a speed of 10 km/hr) is by two propellers.

Principal characteristics of the LAV are a fighting weight of 12.9 tons, a length of 6.4 m, a width of 2.5 m, a height of 2.69 m, maximum highway speed of 100 km/hr, and a range of around 670 km.

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